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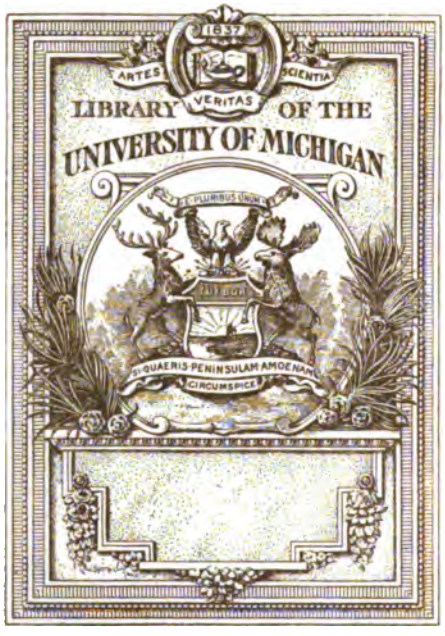
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NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

.....

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body it must include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.

NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

.....

Membership of

.....

Application Received

.....189 .

Action by Board of Government,.....favorable.

.....189 .

Voted by the Association,.....elected,

.....189 .

New England Cotton Manufacturers' As'

Room 57, International Trust I

45 MILK STREET,

BOSTON, MASS

PROPOSAL FOR MEMBER

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. .....

Position, ...

P. O. Address, ...

is proposed for ..... *membership in the* NEW ENGLAND COTTON
active or associate

MANUFACTURERS' ASSOCIATION *by* .....
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full, particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

.....

.....

.....

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.....

The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 189 .

.....
signature of candidate.

Stephen A. Knight

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 65.

SEMI-ANNUAL MEETING.

Held at the Crawford House, White Mountains, New Hampshire,

SEPTEMBER 27-29, 1898.

Office of the Association:

Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

WALTHAM, MASS.:
PRESS OF E. L. BARRY,
1898.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1898
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members, but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Commonwealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,
Secretary of the Commonwealth.

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership.

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars. Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause,

at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2, excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

ARTICLE 5. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 6. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 7. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years.

DUTIES OF OFFICERS.

ARTICLE 8. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 9. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 10. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 11. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of

their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 12. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

MEETINGS.

ARTICLE 13. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 14. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each member, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 15. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1898.

PRESIDENT.

STEPHEN A. KNIGHT, ... PROVIDENCE, R. I.

VICE-PRESIDENTS.

FRED C. McDUFFIE, ... LAWRENCE, MASS.
HENRY T. WHITIN, ... NORTHBRIDGE, MASS

DIRECTORS.

ALBERT F. KNIGHT, ... ANTHONY, R. I.
JOHN ECCLES, ... TAFTVILLE, CONN.
GEORGE H. HILLS, ... FALL RIVER, MASS.
CHAS. H. RICHARDSON, . . . CLINTON, MASS.
JOHN TEMPEST MEATS, . . . TAUNTON, MASS.
GEORGE F. WHITTEN, . . . MANCHESTER, N. H.

AUDITOR.

J. HERBERT SAWYER, ... BOSTON, MASS.

SECRETARY.

C. J. H. WOODBURY, P. O. Box 3672, BOSTON, MASS.

OFFICE OF THE ASSOCIATION:

ROOM 57, INTERNATIONAL TRUST BUILDING, 45 MILK STREET, CORNER OF DEVONSHIRE STREET, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	Walter E. Parker,	1889–92
Amos D. Lockwood,	1878–80	Robert McArthur,	1892–94
John Kilburn,	1880–83	Edw. W. Thomas,	1894–95
William C. Lovering,	1883–85	A. M. Goodale,	1895–96
Richard Garsed,	1885–86	Arthur H. Lowe,	1896–97
J. S. Ludlam,	1886–88	Russell W. Eaton,	1897–98
Henry F. Lippitt,	1888–89	STEPHEN A. KNIGHT,	1898–

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Walter E. Parker,	1885–89
William A. Burke,	1865–73	Richard B. Borden,	1886–88
John C. Palfrey,	1873–76	Arnold B. Sanford,	1888–91
Edward Atkinson,	1876–78	Robert McArthur,	1889–92
A. G. Cumnock,	1877–80	Simeon B. Chase,	1891–93
Charles Nourse,	1878–81	E. W. Thomas,	1892–94
William F. Goulding,	1880–83	A. M. Goodale,	1893-95
Richard Garsed,	1881–85	William J. Kent,	1894–97
J. S. Ludlam,	1883–86	FRED. C. McDUFFIE,	1895–
		HENRY T. WHITIN,	1897–

DIRECTORS.

J. S. Davis,	1865–69	A. M. Wade,	1868–69
Charles Nourse,	1865–78	D. J. Johnston,	1869–70
Phineas Adams,	1865–74	A. G. Cumnock,	1869–77
William P. Haines,	1865–69	F. E. Clarke,	1869–75

DIRECTORS.—Concluded.

Thomas J. Borden,	1865–78	Robert McArthur,	1886–89
Daniel D. Crombie,	1865–68	S. S. Spencer,	1887–90
Cyrus I. Barker,	1875–80	E. W. Thomas,	1888–92
Hervey Kent,	1877–81	William W. Whitin,	1888–93
David J. Johnston,	1878–82	Robert R. Smith,	1889–92
Walter Paine, 3d,	1878–80	Alfred M. Goodale,	1890–93
Chas. L. Lovering,	1878–83	William J. Kent,	1891–94
Richard Garsed,	1880–81	Herman F. Straw,	1891–93
William H. Jennings,	1880–83	Fred C. McDuffie,	1892–95
Chas. D. McDuffie,	1881–83	George W. Bean,	1892–95
Walter E. Parker,	1881–85	F. M. Messenger,	1893–95
John W. Danielson,	1881–85	Arthur H. Lowe,	1894–96
William E. Barrows,	1882–83	Henry T. Whitin,	1894–97
Rufus A. Maxfield,	1883–86	Herbert L. Pratt,	1895–98
George W. Weeks,	1883–86	Stephen A. Knight,	1895–98
Henry S. Howe,	1883–87	Russell W. Eaton,	1896–97
Richard B. Borden,	1883–86	ALBERT F. KNIGHT,	1893–
O. S. Brown,	1885–91	JOHN ECCLES,	1895–
Henry F. Lippitt,	1885–88	C. H. RICHARDSON,	1897–
Wilbur A. Stiles,	1886–88	GEORGE H. HILLS,	1897–
Stephen N. Bourne,	1886–91	JOHN T. MEATS,	1898–
John Kilburn,	1870–80	GEO. F. WHITTEN,	1898–
William P. Haines,	1874–78		

AUDITORS.

Benjamin Saunders,	1865–71	Henry D. Sullivan,	1873–82
John C. Palfrey,	1871–73	J. HERBERT SAWYER,	1882

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. WOODBURY,	1894

MEMBERS OF THE ASSOCIATION.

October 1, 1898.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

George Arms	Grand Hotel	New York City	Oct. 16, 1872.
Jones S. Davis	6 Newton St.,	Holyoke, Mass.	Oct. 27, 1897.
Ambrose Eastman	53 State St.	Boston, Mass.	Sept. 27, 1894.
Samuel Webber	Hydraulic Engineer	Charlestown, N. H.	Apr. 28, 1897.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co. 35 Grove St.,	Adams, Mass.	Apr. 29, 1896.
Stephen L. Adams	Treas. Stafford Mfg. Co.	Central Falls, R. I.	Apr. 24, 1895.
Joseph D. Aiken	Ponemah Mills	Taftville, Conn.	Oct. 28, 1891.
F. S. Akin	Supt. Cornell Mills	Fall River, Mass.	Sept. 27, 1894.
Charles T. Aldrich	Treas. Aldrich Mfg. Co. Box 34,	Providence, R. I.	Apr. 28, 1886.
B. A. Alexander	Supt. Boston Duck Co.	Bondsville, Mass.	Apr. 28, 1898.
George E. Ames	Mech. Supt. Lawrence Mfg. Co.	Lowell, Mass.	Apr. 24, 1895.
William Ames	Treas. Fletcher Manufg. Co., Box 83, 47 Charles St.,	Providence, R. I.	Apr. 30, 1879.
Charles B. Amory	Treas. Hamilton Manufg. Co. 70 Kilby St.,	Boston, Mass.	Apr. 25, 1894.
Thomas Armstrong	Supt. No. Pownal Mfg. Co.	No. Pownal, Vt.	Oct. 27, 1897.

John W. Arrington . . Treas. & Agt. Edna Cotton Mills . . Reidsville, N. C. . . Oct. 24, 1895.
Abel T. Atherton . . . Machine Maker . . . . . Bay Side, R. I. . . . Oct. 16, 1872.
Edward Atkinson . . . Prest. Boston Mfrs. Mu. Fire Ins. Co. . . . . 31 Milk St., Boston, Mass. . . . Apr. 19, 1871.
Edward W. Atkinson . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . Oct. 27, 1886.
H. C. Atwood . . . . Treas. Williamsville Manufg. Co. . . Providence, R. I. . . . Apr. 29, 1885.
James A. Atwood . . . Agt. Wauregan Mills and Quinebaug Co. . . . . Wauregan, Conn. . . Oct. 28, 1891.
John Walter Atwood . Supt. Wauregan Mills . . . . . Wauregan, Conn. . . Oct. 24, 1895.
W. E. Atwood . . . . Secy. and Asst. Treas. Williamsville Manufg. Co. . . . . Killingly, Conn. . . . Sept. 27, 1894.
George A. Ayer . . . Supt. City Manufg. Corporation . . . . . 123 Fifth St., New Bedford, Mass. . Apr. 24, 1895.

Charles L. Bailey . . . Gen. Supt. Boston Manufg. Co. . . . . Box 143, Waltham, Mass. . Sept. 27, 1894.
Henry A. Bailey . . . Agt. Chicopee Manufg. Co. . . . . Chicopee Falls, Mass. Oct. 25, 1893.
Edwin H. Baker . . . Bliss, Fabyan & Co., Box 2899 . . . . . 117 Duane St., New York City, N. Y. Apr. 24, 1878.
Philip S. Baker . . . . Sec. and Treas. Crowders Mountain Cotton Mills . . . . . Kings Mt., N. C. . . Oct. 24, 1895.
Edward R. Ballou . . . Supt. Brighton Mills . 540 West 23rd St., New York City . Apr. 25, 1894.
William P. Bancroft . . Vice-Pres. Joseph Bancroft & Sons Co. . . . . Wilmington, Del. . . Oct. 31, 1883.
A. D. Barker . . . . . Agt. Avon Manufg. Co. . . . . Lewiston, Me. . . . Apr. 19, 1871.
Lewis E. Barnes . . . Agt. Pemberton Co. & Methuen Co., Methuen, Mass. . . . Oct. 24, 1895.
William A. Barrell . . Agt. Lawrence Duck Co. . . . . Lawrence, Mass. . . Apr. 30, 1884.
Edwin N. Bartlett . . . Supt. Sigourney and Rockdale Mills, North Oxford, Mass. . Apr. 29, 1891.
Daniel Moore Bates, Jr. Asst. Supt. Joseph Bancroft & Sons Co., Wilmington, Del. . . Apr. 28, 1898.
Joseph P. Battles . . . Asst. Mgr. Amer. Drosophore Co., Box 1460 . . . . . 66 Equitable Building, 150 Devonshire St., Boston, Mass. . . . Oct. 24, 1895.
George W. Bean . . . Agt. Androscoggin Mills . . . . . Lewiston, Me. . . . Apr. 17, 1872.
Robert Beatty . . . . Robert Beatty & Co. . . . . Coral and Adams Sts., Philadelphia, Pa. . . Oct. 27, 1897.
Truman Beckwith . . . Treas. Dyerville Manufg. Co. . Box 171, Providence, R. I. . Apr. 27, 1892.
John Bell . . . . . Asst. Treas. and Mgr. Smith & Dove Manufg. Co. . . . . Andover Mass. . . . Oct. 27, 1897.
A. C. Bent . . . . . Agt. Safety Seamless Pocket Co. . . Taunton, Mass. . . . Oct. 27, 1897.
W. N. Blackstone . . . Treas. Attawaugan Co. and Totokett Mills Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
J. H. Blades . . . . . Supt. Lorraine Manufg. Co. . . . . Westerly, R. I. . . . Apr. 28, 1898.
William W. Blades . . Gen. Supt. Lorraine Mfg. Co. . . . . 66 West Ave., Pawtucket, R. I. . . Oct. 25, 1893.
T. Ashby Blythe . . . Proprietor Ashby Cotton Mills . . . . . 114 Chestnut St., Philadelphia, Pa. . . Oct. 27, 1897.

John P. Bodge	Treas. Arkwright Mills	Fall River, Mass.	Oct. 27, 1897.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Richard B. Borden	Treas. Richard Borden Mfg. Co. / Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 18, 1866.
Thomas J. Borden	Pres. Richard Borden Manufg. Co.	Box 118, Fall River, Mass.	Apr. 20, 1865.
E. S. Boss	Agt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
Stephen N. Bourne	Agt. Stark Mills	Manchester, N. H.	Oct. 21, 1869.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen	Riverpoint, R. I.	Oct. 24, 1895.
A. W. Brainerd	Supt. H. N. Slater Mills	Webster, Mass.	Apr. 28, 1898.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
Christopher P. Brooks	Director The American Correspondence School of Textiles	P. O. Box 1035, Lowell, Mass.	Apr. 28, 1897.
Henry R. Brown	Supt. Hope Co. and Phenix Mill	Phenix, R. I.	Apr. 28, 1897.
Isaac A. Brown	Treas. Narragansett Mills	Fall River, Mass.	Sept. 29, 1898.
James W. Brown	P. O. Box 312,	Ipswich, Mass.	Oct. 24, 1895.
O. S. Brown	Agt. Salmon Falls Manufg. Co.	Salmon Falls, N. H.	Apr. 21, 1875.
Thomas J. Brown	George Brown's Sons	Mt. Joy, Penn.	Oct. 27, 1897.
E. C. Bucklin	Treas. Interlaken Mills, / Treas. Harris Mfg. Co.	Box 289, Providence, R. I.	Apr. 25, 1883.
Robert Burgess	Supt. Pierce Mfg. Corp.	New Bedford, Mass.	Apr. 27, 1892.
Edward N. Burke	Lowell Machine Shop	Lowell, Mass.	Apr. 28, 1880.
W. R. Burnham	Treas. Universal Loom Co.	Norwich, Conn.	Apr. 29, 1885.
William D. Cadwell	Agt. Nashua Mfg. Co. & Jackson Co.,	Nashua, N. H.	Apr. 19, 1871.
John P. Campbell	Supt. New York Mills,	New York Mills, Oneida Co., N. Y.,	Sept. 22, 1896.
Byron F. Card	Agt. Howland Mills	New Bedford, Mass.	Apr. 25, 1888.
Arnold B. Chace, Jr.	Agt. Valley Falls Co. Woonsocket Mills	Valley Falls, R. I.	Apr. 24, 1895.
George A. Chace	Treas. Bourne Mills	Fall River, Mass.	Apr. 25, 1877.
H. S. Chadwick	Pres. Dover Yarn Mill / Pres. Dilling Cotton Mills	204 S. Tryon St., Charlotte, N. C.	Apr. 24, 1895.
Simeon B. Chase	Treas. King Philip Mills	Fall River, Mass.	Apr. 21, 1875.
Clarence N. Childs	Asst. Supt. Hamilton Manufg. Co.	43 Pine St., Lowell, Mass.	Apr. 24, 1895.
Elmer G. Childs	Agt. Boston Duck Co.	Bondsville, Mass.	Oct. 26, 1892.
Jno. H. C. Church	Asst. Treas and Sec. Monument Mills,	Gt. Barrington, Mass.	Apr. 28, 1897.
Alfred Clarke	Mechanical Engineer, 23 Central St.,	Boston, Mass.	Apr. 30, 1879.
Ernest E. Clark	H. N. Slater Mills	Webster, Mass.	Apr. 29, 1896.
Frederick E. Clarke	Pres. Boston & Lowell R. R. Co.	Lawrence, Mass.	Apr. 20, 1865.
George A. Clark	Supt. Manchester Mills	Manchester, N. H.	Oct. 25, 1882.
E. N. Clemence	Sec. and Treas. Eagle & Phenix Mfg. Co. and Agt. for Receivers	Columbus, Ga.	Apr. 28, 1897.
W. H. Cloher, Jr.	Treas. Utica Cotton Co.	Capron, Oneida Co., N. Y.	Sept. 22, 1896.
Alonzo A. Coburn	Treas. Atherton Machine Co.	Lowell, Mass.	Apr. 25, 1888.

Josiah G. Coburn		Newton, Mass.	Apr. 20, 1865.
John A. Collins	Supt. American Linen Co.	73 Cottage St., Fall River, Mass.	Oct. 31, 1883.
Frank B. Comins	Vice-Pres. & Gen'l M'g'r. U. S. Aerophor Air Moistening and Ventilating Co.	P. O. Box 1555 Providence, R. I.	Oct. 28, 1891.
John J. Connell	Supt. Cohannet Mills	Taunton, Mass.	Apr. 27, 1892.
Alphonse S. Covel	Treas. Tremont and Suffolk Mills,	70 Kilby St., Boston, Mass.	Oct. 31, 1877.
William W. Crapo	Pres. Wamsutta Mills	New Bedford, Mass.	Sept. 29, 1898.
P. T. Creed	Supt. Hopewell Mills	Box 356, Taunton, Mass.	Sept. 22, 1896.
John B. Cudlip	Supt. Gibson Cotton Mills	Marysville, N. Bruns.	Apr. 28, 1897.
H. H. Culver	Supt. Elizabeth Poole Mill	Taunton, Mass.	Apr. 28, 1897.
Henry S. Culver	Supt. Westville Cotton Mill	Taunton, Mass.	Apr. 28, 1897.
A. G. Cumnock	Treas. Appleton Co.	Lowell, Mass.	Oct. 28, 1885.
Andrew J. Currier	Mgr. Albion and Valley Falls Co.	Valley Falls, R. I.	Apr. 25, 1888.
T. B. Dallas	Treas. Phœnix Cotton Mills Treas. Dallas Manufg. Co.	Box 8386, Nashville, Tenn.	Oct. 24, 1895.
Philip Dana	Supt. Dana Warp Mills	Westbrook, Me.	Sept. 29, 1898.
Woodbury K. Dana	Treas. Dana Warp Mills	Westbrook, Me.	Apr. 25, 1888.
Albert W. Danforth	Supt. & Engineer Shanghai Cot. Cloth Mills,	Shanghai, China	
		881 Bridge St., Lowell, Mass.	Apr. 27, 1881.
A. Lockwood Danielson	Asst. Treas. Quinebaug Co.,	Box 900, Providence, R. I.	Sept. 27, 1894.
J. DeForest Danielson	Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works	Providence, R. I.	Sept. 27, 1894.
John W. Danielson	Treas. Lockwood Co.	Box 900, Providence, R. I.	Jan. 15, 1868.
B. D. Davol	Pres. Barnard Mfg. Co.	P. O. Box 418, Fall River, Mass.	Apr. 25, 1877.
James C. Deane	Supt. Griswoldville Manufg. Co.	Griswoldville, Mass.	Apr. 25, 1894.
George DeForest	Treas. Mohawk Valley Mills Treas. Utica Steam Cotton Mills	Utica, New York	Oct. 27, 1897.
William P. Dempsey	Agt. Dempsey Bleachery and Dye Works,	Pawtucket, R. I.	Apr. 28, 1886.
Charles W. Dennett	Agt. Johnson Manufg. Co. Agt. Dunbar Mills Co.	North Adams, Mass.	Oct. 29, 1890.
Edward P. Dennis	Lowell Machine Shop	Lowell, Mass.	Apr. 25, 1888.
Charles A. Denny	Vice-Pres. and Gen. Mgr. American Card Clothing Co.	Leicester, Mass.	Apr. 25, 1888.
P. Y. DeNormandie	Agt. Potomska Mills	New Bedford, Mass.	Apr. 29, 1896.
Charles Owen Dexter	Mgr. Canadian Col'd Cot Mills, Ltd.	Hamilton, Ont.	Apr. 24, 1895.
Samuel Dibble	Pres. Enterprise Cotton Mills,	Orangeburg, S. C.	Sept. 29, 1898.
John W. Dickinson	Supt. Lyman Mills	Holyoke, Mass.	Oct. 27, 1897.
F. Dilling	Sec'y & Treas. Dilling Cotton Mills	Kings Mountain, N. C.	Oct. 24, 1895.
Albert W. Dimick	Agt. Indian Head Mills of Alabama,	Cordova, Ala.	Apr. 25, 1894.
Eben S. Draper	Agt. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George A. Draper	Treas. Draper Co.	Hopedale, Mass.	Oct. 31, 1888.
George Otis Draper	Sec'y Draper Co.	Hopedale, Mass.	Apr. 24, 1895.
William F. Draper	Pres. Draper Co.	Hopedale, Mass.	July 17, 1867.
William F. Draper, Jr.	Draper Co.	Hopedale, Mass.	Oct. 29, 1890.

John Drowne	Supt. Cocheco Mfg. Co.	Dover, N. H.	Apr. 29, 1896.
Joseph M. Dunham	Supt. Merrick Thread Co. 190 Walnut St.	Holyoke, Mass.	Oct. 26, 1892.
David H. Dyer	D. H. Dyer & Son, Mill Engineers 7 and 8 Pocassett Bank Building	Fall River, Mass.	Oct. 18, 1871.
William A. Eastman	Treas. Lowell Hosiery Co.	Lowell, Mass.	Apr. 24, 1878.
Russell W. Eaton	Agt. Cabot Manufg. Co.	Brunswick, Me.	Oct. 26, 1887.
John Eccles	Supt. Ponemah Mills	Taftville, Conn.	Apr. 27, 1892.
D. M. Ehrlich	Sec'y & Treas. Galveston Cotton Mills,	Galveston, Texas.	Apr. 24, 1895.
Lawrence V. Elder		Dickinson, Texas	Oct. 27, 1886.
Oscar Elsas	Vice-Pres. Fulton Bag & Cotton Mills, P. O. Box 773,	Atlanta, Ga.	Apr. 28, 1897.
Frederick W. Ely	Agt. Columbian Manufg. Co.	Greenville, N. H.	Apr. 25, 1888.
H. B. Estes	Agt. Continental Mills	Lewiston, Me.	Apr. 26, 1893.
William Evans	Supt. Richard Borden Mfg. Co.	Fall River, Mass.	Apr. 29, 1896.
C. E. Falls	Sec. and Treas. Enterprise Mills	Kings Mountain, N. C.	Oct. 24, 1895.
Herbert R. Farnum	Supt. Bernon Mill	Georgiaville, R. I.	Apr. 27, 1881.
Charles F. Farrar	Supt. Wm. A. Slater Mills Corp.	Slatersville, R. I.	Oct. 27, 1897.
Frank S. Field	Supt. & Agt. Massaemit Yarn Mills	Shattuckville, Mass.	Oct. 24, 1895.
William Firth	Mgr. Am. Drosophore Co. 150 Devonshire St.,	Boston, Mass.	Apr. 25, 1888.
Charles H. Fish	Agt. Cocheco Manufg. Co.	Dover, N. H.	Apr. 27, 1887.
Henry E. Fisher	Vice-Pres. & Agt. Atlanta Cotton Mills	Atlanta, Ga.	Oct. 24, 1895.
Herbert Fisher		Taunton, Mass.	Oct. 29, 1879.
William B. Fitz	Supt. West Boylston Manufg. Co.	Oakdale, Mass.	Oct. 26, 1892.
Frederick A. Flather	Mech. Engineer & Foreman Lowell Machine Shop	Lowell, Mass.	Apr. 29, 1891.
M. F. Foster		Milford, N. H.	Apr. 17, 1872.
Philip H. Fowler		Gloucester City, N. J.	Nov. 30, 1881.
Edward W. France	Dir. of Philadelphia Textile School, Broad and Pine Streets,	Philadelphia, Pa.	Sept. 22, 1896.
C. H. Frisbie	Agt. Attawaugan Co.	Norwich, Conn.	Oct. 29, 1890.
W. T. Galey	Pres. Aberfoyle Manufg. Co.	Chester, Pa.	Apr. 28, 1897.
William Gammell	Agt. Berkeley Co.	Providence, R. I.	Oct. 28, 1885.
James G. Garland	10 Adams St.	Biddeford, Me.	Oct. 29, 1879.
Edward T. Garsed	Treas. Hucomuga Mills	Greensboro, N. C.	Apr. 28, 1898.
Joshua Garsed	Wingohocking, Mills, Frankford	Philadelphia, Pa.	Oct. 27, 1897.
James A. Gary	Alberton Mills . 108 W. German St.,	Baltimore, Md.	Apr. 25, 1883.
James Gee	Mgr. Interlaken Dye Works	Fiskville, R. I.	Apr. 28, 1898.
Charles E. Getchell	Supt. Waltham Bleachery and Dye Works 35 Willow St.,	Waltham, Mass.	Oct. 30, 1889.

Daniel Gilligan	Supt. Pocasset and Metacomet Mills,	Fall River, Mass.	Apr. 29, 1896.
John Gilligan	Mgr. Fort Mills Manufacturing Co.,	Fort Mills, S. C.	Sept. 29. 1898.
William C. Godfrey	Agt. Indian Orchard Co.	Indian Orchard, Mass.	Oct. 29, 1890.
Alfred M. Goodale	Treas. Boston Manufg. Co. 50 State St.,	Boston, Mass.	Apr. 25, 1883.
Charles H. Gorton	Agt. Glenark Knitting Co.	Woonsocket, R. I.	Apr. 25, 1894.
Marcellus Gould	Agt. Falls Company	Norwich, Conn.	Sept. 22, 1896.
William B. Gowdey	Mill Supplies 40 Clifford St. Box 707,	Providence, R. I.	Apr. 30, 1890.
George P. Grant, Jr.	Treas. Grant Yarn Co.	Fitchburg, Mass.	Sept. 27, 1894.
D. W. Gray	Supt. Skenandoa Cotton Co.	Utica, N. Y.	Oct. 26, 1892.
R. A. Gray	Supt. Rodman Manufg. Co.	Allenton, R. I.	Apr. 24, 1895.
Stephen Greene	Mill Architect and Engineer 131 Devonshire St.,	Boston, Mass.	Oct. 27, 1886.
William C. Greene	Gen. Mgr. Peace Dale Manufg. Co.	Peace Dale, R. I.	Oct. 27, 1886.
Joseph Warren Greene	Supt. Hamilton Web Co.	Hamilton, R. I.	Apr. 29, 1896.
John Gregson	Supt. Merchants Manufg. Co.	Fall River, Mass.	Apr. 24, 1895.
Maxwell Grierson	Gn. Mgr. Jas. Chadwick & Bro., Ltd.,	Jersey City, N. J.	Apr. 28, 1898.
Frederick Grinnell	Pres. Gen. Fire Extinguisher Co.	New Bedford, Mass.	Apr. 24, 1878.
David Grove	Supt. Dyerville Manufg. Co. 610 Manton Ave.,	Providence, R. I.	Apr. 28, 1898.
H. S. Grove	Pres. and Gen. Mgr. Argo Mills Co., 218 Race St.,	Philadelphia, Pa.	Apr. 28, 1898.
Arthur H. Gulliver	Asst. Supt. Lonsdale Co.	Ashton, R. I.	Apr. 24, 1889.
B. F. Guy	Gen. Supt. Pelzer Manufg. Co.	Pelzer, S. C.	Apr. 24, 1895.

Frank J. Hale	Agt. Saco and Pettee Machine Shops Newton Upper Falls,	Mass.	Apr. 27, 1892.
Samuel Hale	Vice-Pres. and Gen. Manager Dixie Cotton Mills	La Grange, Ga.	Apr. 29, 1891.
William E. Hall	Treas. Shaw Stocking Co.	Lowell, Mass.	Apr. 27, 1892.
Z. D. Hall	Supt. Berkshire Cotton Mfg. Co. P. O. Box 963,	Adams, Mass.	Oct. 29, 1879.
John H. Hambly	Treas. Quidnick Manufg. Co. 49 Westminster St.,	Providence, R. I.	Apr. 24, 1895.
A. M. Hamilton	Supt. Parker Mills	Fall River, Mass.	Apr. 28, 1897.
John F. Hamlet	P. O. Box 160	Fall River, Mass.	Oct. 31, 1888.
Joseph O. Hannum	Agt. Saratoga Victory Manufg. Co. Victory Mills,	Saratoga Co., N. Y.	Apr. 30, 1890.
Frank Harris	Hamlet Mills	Woonsocket, R. I.	Apr. 24, 1889.
Henry F. Harris	Treas. West Boylston Manufg. Co. 340 Main St.,	Worcester, Mass.	Apr. 30, 1890.
John J. Hart	Charlton Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Samuel E. Hathaway	Supt. Fall River Iron Works Co.	Fall River, Mass.	Sept. 27, 1894.
William Hathaway	Supt. Barnard Manufg. Co.	Fall River, Mass.	Apr. 25, 1894.
William B. Hawes	Treas. No. Dighton Cotton Co.	Fall River, Mass.	Oct. 24, 1895.

Alfred Hawkesworth	Supt. Merchants Cotton Co.	Montreal, P. Q.	Apr. 26, 1893.
Fred Hawkesworth	Asst. Supt. Merchants Cotton Co.	Montreal, P. Q.	Sept. 22, 1896.
Horace L. Hayden		Braintree, Mass.	Apr. 24, 1895.
William Hayes	Agt. Barker Mill	Auburn, Me.	Apr. 30, 1879.
W. G. Henderson	Agt. Shetucket Co.	Norwich, Conn.	Apr. 29, 1896.
James G. Hill	Cotton Manufr., 749 Merrimack St.,	Lowell, Mass.	Jan. 15, 1868.
William R. Hill	Treas. Glasgow Manufg. Co.	South Hadley Falls, Mass.	Oct. 25, 1893.
George H. Hills	Treas. Davol Mills & Stevens Mfg. Co.	Fall River. Mass.	Oct. 24, 1895.
Charles H. Hobbs	Agt. Thorndike Co.	Thorndike, Mass.	Apr. 28, 1886.
Louis L. Hohn	Supt. Wm. Clark Thread Co., 122 High St.,	Westerly, R. I.	Apr. 28, 1897.
John Holland	12 Trackey St.	P. O. Box 96, Dover, N. H.	Oct. 31, 1877.
Gideon F. Holmes	Treas. and Gen. Mgr. Plymouth Cordage Co.	No. Plymouth, Mass.	Oct. 30, 1889.
George W. Holt	Agt. Monohansett Manufg. Co.	Putnam, Conn.	Oct. 29, 1879.
William P. Holt	Agt. William A. Slater Mills Corp.	Box 315, Slatersville, R. I.	Oct. 25, 1893.
George L. Hooper	7 Belmont St.,	Lowell, Mass.	Apr. 27, 1892.
Jno. Hopkinson	Gen. Mgr. Slayden & Kirksey Woolen Mills	Waco, Texas	Apr. 25, 1883.
Thomas Horsfield	Supt. Hargrave's Mills	465 Warren St., Fall River, Mass.	Oct. 27, 1897.
Henry S. Houghton, Jr.	Supt. Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 24, 1895.
W. C. Houston, Jr.	Pres. Hope Mills Manufg. Co.	333 Drexel Building, Philadelphia, Pa.	Apr. 28, 1897.
Elisha H. Howard	Treas. Harris Textile Co.	Providence, R. I.	Apr. 25, 1883.
Henry S. Howe	Dry Goods Commission, 68 Chauncy St.,	Boston, Mass.	Oct. 31, 1877.
Albert C. Hoy	Asst. Supt. Hamlet Mills	Woonsocket, R. I.	Apr. 28, 1898.
W. S. Hume	Supt. Dominion Cotton Mills, Ltd.	Hochelaga, P. Q., Can.	Oct. 29, 1890.
Arthur W. Hunking	Agt. Mass. Mills, in Georgia	Lindale, Floyd County, Ga.	Apr. 24, 1895.
D. Edwin Irving	Treas. The Irving & Leiper Mfg. Co.,	Chester, Pa.	Oct. 27, 1897.
J. E. Jenckes	Treas. E. Jenckes Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Edward B. Jennings	Treas. Globe Yarn Mills	Fall River, Mass.	
David L. Jewell	Agt. China, Webster & Pembroke Mills	Suncook, N. H.	Apr. 20, 1865.
C. W. Johnston	Treas. The Highland Park Mfg. Co.,	Charlotte, N. C.	Apr. 28, 1898.
David S. Johnston	Treas. Cohoes Iron Foundry & Mach. Co.,	Cohoes, N. Y.	Oct. 28, 1891.
W. T. Jordan	Mgr. Mountain Island Mfg. Co.	Mountain Island, N. C.	Oct. 24, 1895.
Frank E. Kaley	Treas. Morse & Kaley Mfg. Co.	Milford, N. H.	Oct. 24, 1895.
W. E. Keach	Supt. Grant Yarn Co.	123 Myrtle Ave., Fitchburg, Mass.	Oct. 26, 1892.
Roland R. Kelly	Supt. Williamstown Manufg. Co.	Williamstown Sta., Mass.	Nov. 30, 1881.
Joseph H. Kendrick	Agt. American Supply Co.	Box 850, Providence, R. I.	Apr. 30, 1879.
George E. Kent	Gen. Mgr. Exeter Manufg. Co.	Pittsfield, N. H.	Oct. 31, 1888.

Hervey Kent	Pres. Exeter Manufg. Co.	Exeter, N. H.	Apr. 20, 1865.
Nathaniel B. Kerr	Agt. Grinnell Manufg. Corp.	New Bedford, Mass.	Oct. 26, 1892.
John Kilburn		Belmont, Mass.	Apr. 20, 1865.
Harry W. Kimball		Kingston, Ontario, Can.	Oct. 24, 1895.
John M. Kimball	Agt. Slatersville Mills Special Atty. Jewett City Mills	4 Market Square, Providence, R. I.	Oct. 31, 1888.
Benjamin B. Kirk	Supt. Shove Mills	P. O. Box 140, 2107 South Main St., Fall River, Mass.	Apr. 28, 1897.
Albert Knight	Supt. Quidnick Mills	Quidnick, R. I.	Apr. 24, 1895.
Albert F. Knight		Auburn, R. I.	Oct. 27, 1886.
C. Prescott Knight	Mgr. River Point Mills	River Point, R. I.	Sept. 29, 1898.
Jesse A. Knight	Sec'y & Supt. Lawton Spinning Co.	Providence, R. I.	Oct. 26, 1892.
Stephen A. Knight	Agt. Hebron Manufg. Co.	Box 820, Providence, R. I.	Oct. 21, 1868.
Walter B. Knight	Reynolds Manufg. Co.	Davisville, R. I.	Apr. 24, 1889.
Webster Knight	Mgr. Natick Mills	Natick, R. I.	Sept. 29, 1898.
Fred Lacey	Supt. Montreal Cotton Co.	Valleyfield, P. Q.	Apr. 24, 1895.
William T. Lang	Agt. Brookside Mills	Knoxville, Tenn.	Apr. 28, 1897.
Walter H. Langshaw	Supt. Dartmouth Manufg. Corp.	New Bedford, Mass.	Apr. 29, 1896.
Elliott Cowdin Lambert	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 24, 1895.
George H. Law	Supt. Bristol Manufg. Corp.	64 Willis St., New Bedford, Mass.	Apr. 28, 1897.
Abbott F. Lawrence	Treas. Nemasket Mills	Box 848, Taunton, Mass.	Apr. 24, 1895.
Harold Lawton	Gen. Mgr. Warwick Mills	Centreville, R. I.	Oct. 27, 1886.
Evan Arthur Leigh	Textile Machinery	70 Kilby St., Boston, Mass.	Oct. 29, 1890.
John Leiper	Supt. Fitchburg Manufg. Co.	W. Fitchburg, Mass.	Oct. 27, 1897.
J. Colby Lewis	Supt. W. A. Slater Mills Corp.	Jewett City, Ct.	Oct. 26, 1892.
Leontine Lincoln	Pres. Seaconnet Mills	Fall River, Mass.	Apr. 28, 1897.
B. F. G. Linnell	Greene & Daniels Mfg. Co.	P. O. Box 645, Central Falls, R. I.	Oct. 27, 1897.
Charles Warren Lippitt	Treas. Silver Spring B. & D. Co.	Providence, R. I.	Oct. 30, 1878.
Henry F. Lippitt	Agt. Social and Manville Cos.	Providence, R. I.	Apr. 27, 1881.
William H. Loftus	Supt. Clark Thread Co.	Newark, N. J.	Oct. 27, 1897.
Robert W. Lord	Agt. R. W. Lord & Co.	Kennebunk, Me.	Oct. 20, 1869.
Ernest Lovering	Agt. Lyman Mills	Holyoke, Mass.	Apr. 25, 1888.
Henry M. Lovering	Agt. Whittenton Manufg. Co.	Taunton, Mass.	Oct. 27, 1880.
William C. Lovering	Pres. Whittenton Mfg. Co.,	40 Water St., Boston, Mass.	Oct. 25, 1876.
William M. Lovering	Supt. Whittenton Manufg. Co.	Taunton, Mass.	Sept. 27, 1894.
Arthur H. Lowe	Treas. Parkhill Manufg. Co.	Fitchburg, Mass.	Oct. 30, 1889.
David Lowe	Asst. Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 24, 1895.
Dudley T. Lyall	Asst. Mgr. Brighton Mills	541 W. 23d St., N. Y.	Sept. 22, 1896.
William L. Lyall	Supt. J. & W. Lyall Loom and Machine Works	540 W. 23d St., New York City	Oct. 26, 1892.
Herbert Lyman	Treas. Hadley Co.	95 Milk St., Boston, Mass.	Oct. 24, 1895.
Otis G. Lynch	Supt. Enterprise Manufg. Co.	Augusta, Ga.	Oct. 24, 1895.
Alvin S. Lyon	Supt. Lowell Manufg. Co.	Lowell, Mass.	Apr. 26, 1882.

James R. MacColl	Treas. Lorraine Manufg. Co.	Pawtucket, R. I.	Apr. 24, 1895.
Charles L. Macomber	Agt. Nemasket Mills	Taunton, Mass.	Apr. 24, 1895.
Charles T. Main	Mech. and Mill Engineer	Exchange Bldg., Boston, Mass.	Oct. 28, 1885.
Charles R. Makepeace	Mill Engineer	Box 973, Providence, R. I.	Apr. 30, 1890.
A. T. Malcolmson	St. Croix Cotton Co.	Milltown, N. B. Can.	Oct. 27, 1897.
Arthur B. Mann	J. H. Martin & Co., Box 465, 99 Franklin St., New York		Apr. 25, 1894.
Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 27, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 272, Griffin, Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin	Supt. Tennessee Mfg. Co.	Nashville, Tenn.	Apr. 28, 1897.
Ira J. Martin	Supt. Bozrahville Co., 62 Conant St.,	Pawtucket, R. I.	Oct. 26, 1892.
John R. Mason	Supt. Laurel Lake Mills	439 Middle St., Fall River, Mass.	Apr. 28, 1897.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Robert McArthur	Agt. Pepperell and Laconia Cos.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAuliffe	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 28, 1898.
Charles D. McDuffie	Agt. Manchester Mills	Manchester, N. H.	Apr. 21, 1869.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2963, 40 Water St., Boston, Mass.	Oct. 25, 1882.
William G. McLoon	Supt. Barnaby Manufg. Co.	Fall River, Mass.	Apr. 27, 1892.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Gen. Supt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
George A. Mebane	Sec. and Treas. Asheville Cotton Mills, Pres. Spray Cotton Mills	Asheville, N. C. / Spray, N. C.	Apr. 28, 1898.
Charles H. Merriman, Jr.	Supt. Globe Mill	Woonsocket, R. I.	Apr. 24, 1895.
Frank M. Messenger	Agt. Grosvenor Dale Co.	No. Grosvenor Dale, Conn.	Apr. 27, 1887.
W. H. Miles	Agt. Farwell Mills	Lisbon, Me.	Sept. 22, 1896.
R. M. Miller, Jr.	Vice Pres. The Atherton Mills	Charlotte, N. C.	Sept. 29, 1898.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	193 Mt. Hope St.	Lowell, Mass.	Apr. 29, 1896.
David Milne	C. J. Milne & Sons	Washington Ave. & 11th St., Philadelphia, Pa.	Apr. 28, 1897.
A. B. Mole	Mgr. Greylock Mill	Adams, Mass.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Blackstone Manufg. Co.	Blackstone, Mass.	Apr. 24, 1895.
J. R. Montgomery	Pres. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 29, 1898.
Fred W. Moore	Agt. Cordis Mills	Millbury, Mass.	Apr. 27, 1892.
Albert H. Morton	Supt. Kitson Machine Co.	Lowell, Mass.	Oct. 28, 1891.
Fred S. Mosher	Supt. Henrietta Mills	Henrietta, Rutherford Co., N. C.	Oct. 24, 1895.
Oliver H. Moulton	Supt. Hamilton Manufg. Co.	Lowell, Mass.	Apr. 20, 1865.
Farquharson J. Muir	Supt. Canadian Col. Cot. Mills Co. Ltd.	Hamilton, Ont., Can.	Apr. 27, 1892.
William B. Munroe		Garwood, N. J.	Oct. 24, 1895.

Roscius C. Newell	Supt. Palmer Mill	Three Rivers, Mass.	Oct. 24, 1895.
William G. Nichols	Supt. Lancaster Mills	Clinton, Mass.	Oct. 25, 1893.
Franklin Nourse	Agt. Lawrence Manufg. Co.	Lowell, Mass.	Apr. 24, 1878.
S. Odenheimer	Treas. Lane Mills	New Orleans, La.	Oct. 25, 1893.
Charles K. Oliver	Treas. Columbia Mills Co.	Columbia, S. C.	Sept. 27, 1894.
Warren M. Orswell	Pres. Orswell and Nockege Mills	Fitchburg, Mass.	Apr. 16, 1873.
J. Edward Osborn	Treas. American Linen Co.	Fall River, Mass.	Apr. 28, 1897.
Oscar L. Owen	Mech. and Mill Eng. Whitin Machine Works	Whitinsville, Mass.	Apr. 25, 1894.
Elmer E. Page	Agt. York Manufg. Co.	Saco, Me.	Apr. 27, 1892.
Francis J. Parker	Treas. Monadnock Mills, 27 Kilby St.,	Boston, Mass.	Jan. 15, 1868.
O. B. Parker	Supt. U. S. Cotton Co.	Central Falls, R. I.	Apr. 24, 1895.
Samuel L. Parker	Supt. Turners Falls Cotton Mills	Box 627, Turners Falls, Mass.	Apr. 29, 1896.
Walter E. Parker	Agt. Pacific Mills, 217 Haverhill St.,	Lawrence, Mass.	Apr. 25, 1877.
John H. Parks	Pres. Wm. Parks & Son, Ltd.	St. John, N. B.	Apr. 24, 1878.
Duncan D. Parmly	Treas. Johnson Mfg. Co. and Dunbar Mills Co.	49 Wall St., New York, N. Y.	Sept. 22, 1896.
John W. Pead	Agt. Merrimack Manufg. Co.	Box 1231, Lowell, Mass.	Apr. 26, 1893.
James R. Pearce	Supt. Edna Cotton Mills	Reidsville, N. C.	Oct. 24, 1895.
William C. Peirce	Pres. Elizabeth Mills, 564 Eddy St.,	Providence, R. I.	Apr. 24, 1895.
William D. Pennell	Agt. Hill Manufg. Co.	Lewiston, Me.	Apr. 16, 1873.
Haven C. Perham	Treas. Kitson Machine Co.	Lowell, Mass.	Apr. 30, 1879.
Henry C. Phillips	New York Mills	Oneida Co., New York, N. Y.	Apr. 25, 1894.
Benjamin Phipps	Treas. Clarendon Mills	4 Winthrop Sq. Boston, Mass.	Sept. 29, 1898.
Andrew G. Pierce, Jr.	Treas. Rotch Spinning Co. Treas. Pierce Manufg. Corp. Treas. Howland Mills Corp.	New Bedford, Mass.	Apr. 24, 1895.
Moses Pierce	Pres. Aspinook Co.	274 Broadway, Norwich, Conn.	Oct. 30, 1878.
Reuben Pilling, Jr.	Supt. Granite Mills Co.	Greenville, R. I.	Apr. 29, 1896.
Charles H. Plummer	Agt. Great Falls Manufg. Co.	Somersworth, N. H.	Apr. 25, 1888.
Charles T. Plunkett	Sec. Berkshire Cotton Mfg. Co.	Adams, Mass.	Apr. 28, 1897.
Herbert L. Pratt	Agt. Bates Manufg. Co.	Lewiston, Me.	Oct. 27, 1875.
T. W. Pratt	Pres. West Huntsville Cotton Mills Co.	Huntsville, Ala.	Sept. 22, 1896.
John E. Prest	Gen. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 17, 1872.
M. W. Quinn	Agt. Hamilton Woolen Co.	Amesbury, Mass.	Oct. 27, 1886.
T. G. Ramsdell	Agt. Monument Mills	Housatonic, Mass.	Oct. 30, 1878.
M. A. Rawlinson	Supt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 24, 1895.

Robert Redford	Agt. Arlington Mills	Lawrence, Mass.	Apr. 26, 1882.
R. S. Reinhardt	Treas. Elm Grove Cotton Mills	Lincolnton, N. C.	Apr. 28, 1898.
James Renfrew	Treas. Renfrew Manufg. Co.	Adams, Mass.	Oct. 18, 1871.
Roscoe C. Reynolds	Agt. Lewiston Machine Co.	Lewiston, Me.	Oct. 25, 1876.
F. H. Rice	394 Pleasant St.,	Worcester, Mass.	Apr. 28, 1880.
Charles H. Richardson	Agt. Lancaster Mills	Clinton, Mass.	Apr. 24, 1889.
C. T. Richmond	Mgr. Fustian Dept. Crompton Co.	Crompton, R. I.	Apr. 28, 1897.
W. H. Richmond	Supt. Bibb Mill No. 2	Macon, Ga.	Oct. 27, 1897.
C. W. Rider	Treas. Merrick Thread Co.	Holyoke, Mass.	Apr. 29, 1896.
Charles E. Riley	Textile Machinery	Box 2815	
		281 Congress St., Boston, Mass.	Apr. 25, 1888.
George W. Robbins	Supt. Barry Cotton Mill	Smithville, Barre, Mass.	Apr. 28, 1897.
Charles D. Robinson	Supt. Crompton Co.	Crompton, R. I.	Sept. 27, 1894.
William A. Robinson	Asst. Supt. Social Manufg. Co.	Woonsocket, R. I.	Apr. 29, 1896.
John R. Rostron	Supt. Indian Head Mills of Alabama,	Cordova, Ala.	Sept. 29, 1898.
John K. Russell	Gen. Mgr. May's Landing Water P. Co. and Millville Manufg. Co.	Millville, N. J.	Apr. 29, 1891.
Arnold B. Sanford	Manufrs. Agent American Cotton Yarn Exchange	45 Milk St., Boston, Mass.	Oct. 25, 1882.
Charles Henry Savage	Supt. Manville Co.	Manville, R. I.	Apr. 26, 1893.
Henry B. Sawyer	Asst. Treas. Newmarket Mfg. Co.		
		45 Milk St., Boston, Mass.	Oct. 27, 1897.
J. Herbert Sawyer	Treas. Newmarket Manufg. Co.		
		Box 2966, 45 Milk St., Boston, Mass.	July 19, 1865.
F. C. Sayles	Pres. Ponemah Mills	Pawtucket, R. I.	Oct. 27, 1897.
George H. Sayward	Mgr. Standard Yarn Co.	Oswego, N. Y.	Oct. 29, 1890.
Arnold Schaer	Supt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
John Scott	Supt. Willimantic Linen Co.	Willimantic, Conn.	Oct. 29, 1879.
Charles M. Sears	Agt. Atlantic Cotton Mills	Lawrence, Mass.	Apr. 28, 1898.
George H. Shapley	Mgr. Silver Lake Co., 78 Chauncy St.,	Boston, Mass.	Apr. 29, 1896.
Frank P. Sheldon	Mill Engineer	Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills	Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co.		
		93 Commercial St., Boston, Mass.	Apr. 29, 1896.
William F. Sherman	Civil Engineer		
		106 New Brazer Bldg., 27 State St., Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills	Box 45, Fall River, Mass.	Oct. 27, 1875.
Herbert H. Shumway	Treas. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 27, 1887.
N. G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 28, 1898.
Louis Simpson	Gen. Mgr. Montreal Cotton Co.	Valleyfield, P. Q.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills	Fall River, Mass.	Oct. 25, 1893.
Arba C. Slater	Supt. Linwood Mills	Linwood, Mass.	Jan. 15, 1868.
Arthur T. Smith	Supt. Langley Manufg Co. Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 24, 1895.

Joel Smith	Supt. The J. P. King Manufg. Co. / Supt. Aiken Manufg. Co.	Augusta, Ga. / Bath, S. C.	Oct. 24, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 27, 1897.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 28, 1898.
Robert R. Smith	Mgr. Greenwoods Co.	New Hartford, Conn.	Oct. 19, 1870.
William O. Smith	Agt. Easthampton Spinning Co.	Easthampton, Mass.	Apr. 28, 1897.
Ellison A. Smyth	Pres. Pelzer Manufg. Co.	Pelzer, S. C.	Oct. 26, 1892.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
William T. Spear	Supt. Jackson Co.	Nashua, N. H.	Oct. 30, 1889.
S. S. Spencer	Supt. Conestogo Steam Mills	Lancaster, Pa.	Oct. 25, 1876.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 28, 1898.
George E. Spofford	Supt. Readville Cotton Mills	Readville, Mass.	Apr. 29, 1896.
Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 24, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 24, 1895.
O. W. Stites		Hoosick Falls, N. Y.	Oct. 24, 1895.
Herman F. Straw	Agt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Walter H. Summersby	Supt. Pontiac Mill and Bleachery	Pontiac, R. I.	Oct. 25, 1893.
Albert A. Sweet	Supt. No. Dighton Cotton Co.	36 Rockland St., Fall River, Mass.	Apr. 26, 1893.
James O. Sweet	Agt. and Treas. Ashland Cotton Co.	Jewett City, Conn.	Apr. 28, 1886.
Edward P. Taft	Treas. Ponemah Mills	Box 1443, Providence, R. I.	Oct. 28, 1885.
Robert Rennie Taft	Supt. Baltic Power Co.	Baltic, Conn.	Apr. 24, 1895.
Robert W. Taft	Treas. Coventry Co.	Box 1144, Providence, R. I.	Sept. 27, 1894.
George P. Taylor		Clinton, Mass.	Oct. 27, 1880.
James W. Taylor	Supt. Canoe River Mills	Box 46, Taunton, Mass.	Oct. 26, 1892.
W. Marshall Taylor	Supt. The Wm. Clark Co.	69 Mechanic St., Westerly, R. I.	Sept. 22, 1896.
Richard Thackeray	Supt. Weetamoe Mills	Fall River, Mass.	Apr. 29, 1885.
Earl A. Thissell	Woonsocket Bobbin Co.	Woonsocket, R. I.	Oct. 30, 1878.
Ariel C. Thomas	Supt. Clinton Manufg. Co.	93 Clinton St., Woonsocket, R. I	Oct. 31, 1888.
Charles E. Thomas	Treas. Forestdale Manufg. Co.	Woonsocket, R. I.	Oct. 31, 1883.
Edward W. Thomas	Agt. Tremont and Suffolk Mills	Lowell, Mass.	Apr. 30, 1884.
Ralph E. Thomson	Supt. Parkhill Manufg. Co.	Fitchburg, Mass.	Apr. 25, 1894.
D. M. Thompson	Pres. & Treas. Corliss Steam Engine Co.	Providence, R. I.	Oct. 28, 1885.
James P. Tolman	Pres. Samson Cordage Works	115 Congress St., Boston, Mass.	Oct. 29, 1890.
D. A. Tompkins	Pres. The Atherton Mills	Charlotte, N. C.	Oct. 24, 1895.
George W. Towne	Supt. Cotton Dept. Arlington Mills	Lawrence, Mass.	Oct. 26, 1892.
William E. Trainer	Pres. Linwood Mills	Trainer, Penn.	Apr. 21, 1875.
Robert B. Treat	Centerville Cotton Mills	Centerville, R. I.	Sept. 27, 1894.
C. H. Truesdell	Supt. Attawaugan Co.	Killingly, Conn.	Oct. 29, 1884.
Edmund E. Truesdell	Supt. China, Webster & Pembroke Mills	Suncook, N. H.	Apr. 26, 1876.

Oscar B. Truesdell	Agt. Fiskdale Mills	Fiskdale, Mass.	Oct. 15, 1873.
George F. Tryon	Supt. Conanicut Mills,	199 Purchase St., Fall River, Mass.	Apr. 28, 1897.
George E. Tucker	Agt. Otis Co.	Ware, Mass.	Oct. 24, 1895.
Charles D. Turnbull	Treas. Wm. A. Slater Mills Corp. The Ludlow,	Boston Mass.	Oct. 27, 1897.
William D. Twiss	Supt. Everett Mills	Lawrence, Mass.	April 29, 1896.
Charles T. Upton	Supt. Shaw Stocking Co.	Lowell, Mass.	Apr. 28, 1897.
George A. Vaughan	Supt. The Putnam Manufg. Co.	Putnam, Conn.	Sept. 22, 1896.
William P. Vaughan	Agt. Putnam Manufacturing Co.	Providence, R. I.	Sept. 29, 1898.
Frank P. Vogl	Agt. Monadnock Mills	Claremont, N. H.	Sept. 27, 1894.
Jude C. Wadleigh	Supt. Mass. Cotton Mills	Lowell, Mass.	Oct. 26, 1892.
Herbert E. Walmesley	Agt. Wamsutta Mills	New Bedford, Mass.	Oct. 29, 1890.
Frederick T. Walsh	Agt. Lowell Bleachery & Dye Works,	Lowell, Mass.	Apr. 28, 1897.
James A. Walsh	Agt. Lewiston Bleachery and Dye Works	Lewiston, Me.	Apr. 27, 1892.
Arthur W. Warren		Newton, N. J.	Apr. 29, 1896.
John Waterman	Treas. Warren Manufg. Co.	Warren, R. I.	Apr. 30, 1884.
Joseph W. Wattles	Manufacturers' Supplies	Canton Junction, Mass.	July 18, 1866.
George W. Weeks		Clinton, Mass.	Apr. 21, 1869.
W. B. Smith Whaley	Mechanical & Mill Engineer Pres. Richland Cotton Mills Granby Cotton Mills,	1328 Main St., Columbia, S. C.	Apr. 24, 1895.
H. D. Wheat	Pres. and Treas. Gaffney Mfg. Co.	Gaffney, S. C.	Apr. 24, 1895.
Channing Whitaker	Infringement and Patentability of Inventions. Lowell Machine Shop	Lowell, Mass.	Oct. 15, 1873.
A. Tenny White	Supt. Manville Co.	Manville, R. I.	Oct. 26, 1887.
Charles D. White	Agt. Uncasville Mfg. Co.	Uncasville, Conn.	Oct. 27, 1897.
Z. L. White	White Brothers	Winchendon, Mass.	Apr. 28, 1897.
Arthur F. Whitin	Pres. Saunders Cotton Mills	Whitinsville, Mass.	Apr. 24, 1895.
Fred B. Whitin	Agt. Uxbridge Cotton Mills	No. Uxbridge, Mass.	Apr. 28, 1897.
Henry T. Whitin	Treas Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 25, 1877.
Alfred N. Whiting	Sec'y and Treas. L. M. Harris Manufg. Co.	Oakdale, Mass.	Apr. 21, 1875.
William S. Whitney	Supt. Mech. Depts., Washington Mills Co.,	Lawrence, Mass.	Apr. 24, 1878.
Arthur Whittam	Supt. The Enterprise Cotton Mills	Orangeburg, S. C.	Apr. 28, 1898.
William Whittam, Jr.		Charlotte, N. C.	Apr. 26, 1893.
George F. Whitten	Agt. Amory Mfg. Co.	Manchester, N. H.	Oct. 26, 1892.
John H. Whitten	Supt. Stark Mills	Manchester, N. H.	Apr. 28, 1898.
Edward B. Wilbur	Supt. Newberry Cotton Mills	Newberry, S. C.	Oct. 30, 1889.
Henry M. Wilcox	Treas. John Rhodes Warp Co.	Millbury, Mass.	Apr. 24, 1889.
Eben C. Willey	Supt. Manchaug Co.	Manchaug, Mass.	Apr. 29, 1896.

Theop. W. Wilmarth	Supt. Millbury Cotton Mills	Millbury, Mass.	Oct. 31, 1883.
Thomas Wilmarth	Supt. Saunders Cotton Mills	Saundersville, Mass.	Apr. 21, 1875.
J. P. Wilson	Treas. Dover Yarn Mills	Charlotte, N. C.	Oct. 24, 1895.
A. S. Winslow	P. O. Box 1494	Providence, R. I.	Oct. 31, 1888.
George Wood	Pres. and Treas. Millville Manufg. Co.	626 Chestnut St., Phila., Pa.	Oct. 16, 1872.
John P. Wood	William Wood & Co.	521 No. 22d St., Philadelphia, Pa.	Apr. 28, 1897.
C. J. H. Woodbury	Secretary and Treasurer	Lynn, Mass.	Oct. 29, 1879.
A. A. Young, Jr.	Treas. Jewett City Mills	Jewett City, Conn.	Sept. 27, 1894.
Adelbert R. Young	Supt. Ashland Cotton Co.	Jewett City, Conn.	Apr. 25, 1894.

ASSOCIATE MEMBERS.

Henry Ashworth	Agt. Card Clothing Manufg. Co.	Fall River, Mass.	Apr. 28, 1897.
George R. Babbitt	Pres. American Oil Co.	182 So. Water St., Providence, R. I.	Apr. 24, 1895.
D. C. Ball	The American Cotton Co.	310 Merchants Exchange, St. Louis, Mo.	Oct. 24, 1895.
George S. Barnum	Secy. and Treas. The Bigelow Co.	New Haven, Conn.	Apr. 24, 1895.
Colin C. Bell	Pres. and Treas. Laminar Fibre Co.	No. Cambridge, Mass.	Apr. 29, 1896.
Frank P. Bennett	Publisher American Wool and Cotton Reporter	148 Pearl St., Boston, Mass.	Sept. 22, 1896.
William H. Bent	Treas. Taunton Machine Works	Taunton, Mass.	April 29, 1896.
J. Payson Bradley	The Kehew-Bradley Co.	24 Purchase St., Boston, Mass.	Apr. 24, 1895.
J. Frank Braids	Mgr. Grease & Oil Dept., Charles S. Bush Co.	212 Weybosset St., Providence, R. I.	Apr. 28, 1897.
Henry G. Brinckerhoff	N. E. Mgr. Fuel Economizer Co., Box 2654	Room 1053, Exchange Bldg., 53 State St., Boston, Mass.	Sept. 22, 1896.
D. Russell Brown	Pres. Brown Bros. Co.	Providence, R. I.	Apr. 24, 1895.
H. Martin Brown	Brown Bros. Co.	Providence, R. I.	Apr. 24, 1895.
John H. Burghardt	Page Belting Co.	31 Pearl St., Boston, Mass.	Apr. 24, 1895.
Eugene E. Burnham	Belt Mfr.	168 Broadway, Lawrence, Mass.	Oct. 24, 1895.
Fred W. Bushnell	Mech. Supt. Narragansett Electric Light Co.	Providence, R. I.	Sept. 29, 1898.
Harry W. Butterworth	Sec. H. W. Butterworth & Sons	2417 East York St., Philadelphia, Pa.	Oct. 27, 1897.
James Butterworth	Pres. H. W. Butterworth & Sons Co.	York and Cedar Sts., Philadelphia, Pa.	Apr. 24, 1895.

French Campbell	Commission Merchant	Manchester, N. H.	Oct. 27, 1897.
Malcolm Campbell	Gen. Mgr. Woonsocket Machine and Press Co.	Woonsocket, R. I.	Apr. 24, 1895.
W. W. Carey	Machinery and Pulley Manufacturer,	Lowell, Mass.	Apr. 24, 1895.
Charles H. Child	Treas. Brown Bros. Co.	Box 890, Providence, R. I.	Apr. 24, 1895.
Henry C. Clark	Treas. Standard Mill Supply Co.,	Box 714, Providence, R. I.	Apr. 28, 1898.
Peter H. Corr	Cotton and Cotton Yarns and Waste	38 Court St., Taunton, Mass.	Apr. 24, 1895.
Thomas G. Cox	Selling Agt. Mason Machine Works	Box 316, Taunton, Mass.	Apr. 24, 1895.
George Crompton	Treas. Crompton & Knowles Loom Works	Worcester, Mass.	Oct. 27, 1897.
Randolph Crompton	Vice-Pres. and Asst. Supt. Crompton & Knowles Loom Works	Worcester, Mass.	Oct. 27, 1897.
Frederick I. Dana	Manager. Thomas Phillips Co.	Providence, R. I.	Apr. 24, 1895.
R. H. Deming	Cotton Broker	10 So. Water St., Providence, R. I.	Apr. 24, 1895.
C. E. W. Dow	Mgr. American Bolt Co.	67 Boott St., Lowell, Mass.	Apr. 24, 1895.
Frederick A. Downes	Sec. Factory Mutual Fire Insurance Cos.	925 Chestnut St., Philadelphia, Pa.	Oct. 27, 1897.
G. B. Emmons	Pres. Emmons Loom Harness Co.	Box 94, Methuen Mass.	Oct. 24, 1895.
T. C. Entwistle	Cotton Machinery Builder	Lowell, Mass.	Apr. 24, 1895.
L. C. Farnsworth	Farnsworth Card Clothing Co.	Pittsfield, Mass.	Oct. 27, 1897.
D. D. Felton	Treas. S. A. Felton & Son Co.	Manchester, N. H.	Apr. 24, 1895.
John W. Ferguson	Builder and General Contractor	253 Broadway, N. Y., and Paterson, N. J.	Apr. 24, 1895.
J. Herbert Foster	Cotton Broker	10 South Water St., Providence, R. I.	Apr. 24, 1895.
George A. Fuller	Mgr. Amer. Card Clothing Co.	Providence, R. I.	Apr. 24, 1895.
Merrill A. Furbush	Treas. M. A. Furbush & Son Machine Co.	224 Market St., Philadelphia, Pa.	Oct. 27, 1897.
John T. Fyans	Agt. Fyans, Frazer & Blackway	411 Beach St., Fall River, Mass.	Apr. 28, 1897.
H. P. Garland	Treas. Loom Picker Co.	Biddeford, Me.	Oct. 24, 1895.
Royal W. Gates	Josiah Gates & Sons, Belting	307 Market St., Lowell, Mass.	Apr. 24, 1895.
Rufus B. Goff	Pres. Standard Mill Supply Co.	77 Exchange Pl., Box 714, Providence, R. I.	Apr. 28, 1897.
William S. Granger	Prest. Granger Foundry & Machine Co.,	Providence, R. I.	Apr. 24, 1895.
Henry T. Grant, Jr.	Pres. Mercantile Mutual Fire Ins. Co.	Banigan Building, Providence, R. I.	Oct. 27, 1897.

William L. Haines . . Agt. for Brooks & Doxey, of Manchester, Eng. . . . .
. . . . . 161 Pearl St., Boston, Mass. . . . Apr. 29, 1896.
A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . .
. . . . . 326 So. Water St., Providence, R. I. . . Oct. 24, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . .
. . . . . Box 409, Fall River, Mass. . . Oct. 27, 1897.
John H. Haworth . . . Haworth & Watson Mfrs. Paper Tubes . . . . . .
. . . . . for Textile Manufg. 43 Columbus Av., Lowell, Mass. . . . Oct. 24, 1895.
Jerome Hill . . . . . Planters' Compress Co. . . . . .
. . . . . 8 Cotton Exchange Bldg., Memphis, Tenn. . . . Apr. 29, 1896.
Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 24, 1895.
Henry S. Houghton, Sr., Mfr. Grids and Beaters . . . . . .
. . . . . 65 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
Alfred A. Hunting . . Mechanical Engineer . . . . . .
. . . . . 26 Mason St., Salem, Mass. . . . Oct. 27, 1897.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 24, 1895.
W. L. Hutchins . . . Asst. Mgr. Crompton & Knowles Loom Works . . . . .
. . . . . Providence, R. I. . . Apr. 28, 1898.

David Jackson . . . { Pres. and Mgr. Jackson Pat. Shell Roll Co. . . . . } Pawtucket, R. I. . . Apr. 24, 1895.

James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
William B. Kehew . . The Kehew-Bradley Co. . 24 Purchase St., Boston, Mass. . Apr. 24, 1895.

Josiah M. Lasell . . . Asst. Treas. Whitin Machine Works, Whitinsville, Mass. . Apr. 24, 1895.
John H. Lorimer . . . Builder of Textile Machines . . . . . .
. . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 27, 1897.
Stephen C. Lowe . . . Mill Supplies . . . . 87 Union St., New Bedford, Mass. . Oct. 24, 1895.
George A. Lowry . . . Consulting Eng. Planters' Comp. Co., ...
. . . . . 89 State St., Boston, Mass. . . . Apr. 28, 1898.

F. H. Maynard . . . . Bus. Mgr. Gen. Fire Extinguisher Co., Providence, R. I. . . Apr. 24, 1895.
H. G. McKerrow . . . Textile Machinery . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
George H. Meader . . Steam Appliances . . 35 Oliver St., Boston, Mass. . . . Apr. 24, 1895.
George B. Morison . . Selling Agt. Hadley Co. 95 Milk St., Boston, Mass. . . . Apr. 24, 1895.

George C. Newell . . . Starkweather & Shepley . . . . . .
. . . . . 17 Custom House St., Providence, R. I. . . Sept. 29, 1898.
William R. Noone . . Mfr. Roller and Slasher Cloth . . . . . .
. . . . . 100 Pearl St., Boston, Mass. . . . Oct. 27, 1897.

Sidney B. Paine . . . General Electric Co., 180 Summer St., Boston, Mass. . . . Apr. 24, 1895.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co., 13 Gold St., New York, N. Y. Apr. 28, 1897.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . Box 315, Providence, R. I. . . Apr. 24, 1895.
Vladimir P. Polevoy . { Agent Great Yaroslavskaia Cotton Mill (of Yaroslave), Russia . . . } 120 Broadway, N. Y. Apr. 28, 1897.
Charles A. M. Praray . Chas. A. M. Praray & Co., Mill Architect and Engineer . . . . . Banigan Building, Providence, R. I. . . Apr. 28, 1897.

Charles F. Randall . . Expert in Textiles . . . . . Room 350, Tremont Building, Boston, Mass. . . . Apr. 24, 1895.
Richard H. Rice . . { Treas. Providence Steam Engine Co. & Rice & Sargent Steam Engine Co. } 521 So. Main St. Providence, R. I. . Apr. 24, 1895.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Insurance & Inspection Co. . . . . 125 Milk St., Boston, Mass. . Apr. 24, 1895.
Louis E. Robinson . . Sea Island Cotton . . . . . Box 1216, 20 Market Square, Providence, R. I. . . Oct. 27, 1897.
John M. Russell . . . Asst. Treas. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.

H. T. Schaefer . . . . Sterling Coal Co. . . . 5 Custom House St., Boston, Mass., Sept. 29, 1898.
E. A. Smith . . . . . Pres. Charlotte Supply Co. . . . . Charlotte, N. C. . . . Oct. 24, 1895.
Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
Lewis R. Speare . . . Alden Speare Sons & Co., Oil and Mill Supplies . . . . . 369 Atlantic Ave., Boston, Mass. . . . . Oct. 24, 1895.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.
George W. Stafford . . Mgr. Crompton & Knowles Loom Works . . . . . Providence, R. I. . . Apr. 24, 1895.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 27, 1897.
William H. Stratton . . Asst. Mgr. Factory Insurance Association . . . . . 95 Pearl St., Hartford, Conn. . . Apr. 28, 1897.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., Providence, R. I. . . Apr. 24, 1895.

Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Charles F. Taylor . . . Owner & Mgr. Burgess Cop Tube Co., Providence, R. I. . . Apr. 28, 1898.
Winthrop Thayer . . . Pres. Thayer & Co., Incorp. . . . . 1015 Tremont Bldg., Boston, Mass. . . . Apr. 29, 1896.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . 7 Eddy St., Providence, R. I. . . Sept. 22, 1896.
William V. Threlfall . . Selling Agt. Saco and Pettee Machine Shops . . . . . Biddeford, Me. . . . Apr. 24, 1895.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Justin A. Ware . . . . Sales Mgr. Crompton & Knowles Loom Works . . . . . Worcester, Mass. . . Oct. 24, 1895.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes . . . . . for Textile Manufg. . Box 996, Lowell, Mass. . . . Oct. 24, 1895.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred A. Wilde . . . . Asst. Mgr. The A. T. Atherton Machine Co. . . . . Pawtucket, R. I. . . Apr. 28, 1897.
Erving Yale Woolley . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . . Apr. 24, 1895.

Honorary Members	4
Active Members	451
Associate Members	99
Total Membership	554

MEMBERS OF THE ASSOCIATION,

October 1, 1898.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Biddeford	James G. Garland	10 Adams St.
Biddeford	H. P. Garland	Loom Picker Co.
Biddeford	Robert McArthur	Pepperell & Laconia Cos.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shop.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	A. D. Barker	Avon Manufg. Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	Roscoe C. Reynolds	Lewiston Machine Co.
Lewiston	James A. Walsh	Lewiston Bleachery and Dye Works
Lisbon	W. H. Miles	Farwell Mills.
Saco	Elmer E. Page	York Manufg. Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	John Drowne	Cocheco Manufg. Co.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	John Holland	12 Trackey St.
Exeter	Hervey Kent	Exeter Manufg. Co.

Greenville	Frederick W. Ely	Columbian Manufg. Co.
Manchester	Stephen N. Bourne	Stark Mills.
Manchester	French Campbell	Commission Merchant.
Manchester	George A. Clark	Manchester Mills.
Manchester	D. D. Felton	S. A. Felton & Sons Co.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Charles D. McDuffie	Manchester Mills.
Manchester	Herman F. Straw	Amoskeag Manufg. Co.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Milford	Frank E. Kaley	Morse & Kaley Manufg. Co.
Nashua	William D. Cadwell	Nashua Manufg. Co. & Jackson Co.
Nashua	William T. Spear	Jackson Co.
Pittsfield	George E. Kent	Exeter Manufg. Co.
Salmon Falls	O. S. Brown	Salmon Falls Manufg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Supt. Adams Bros. Manufg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	A. B. Mole	Greylock Mill.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	James Renfrew	Renfrew Manufg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John Bell	Smith & Dove Manufg. Co.
Barre, Smithville	George W. Robbins	Barre Cotton Mill.
Belmont	John Kilburn	
Blackstone	Edward A. Mongeon	Blackstone Manufg. Co.
Bondsville	B. A. Alexander	Boston Duck Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Boston	Charles B. Amory	70 Kilby St.
Boston	Edward Atkinson	31 Milk St.
Boston	Edward W. Atkinson	152 Congress St.
Boston	Joseph P. Battles	150 Devonshire St.
Boston	Frank P. Bennett	148 Federal St.
Boston	J. Payson Bradley	24 Purchase St.

Boston	Henry G. Brinckerhoff	321 Exchange Building.
Boston	John H. Burghardt	31 Pearl St.
Boston	Alfred Clarke,	Mech. Eng., 23 Central St.
Boston	Alphonse S. Covel	70 Kilby St.
Boston	Ambrose Eastman	53 State St.
Boston	William Firth	150 Devonshire St.
Boston	Alfred M. Goodale	50 State St.
Boston	Stephen Greene	131 Devonshire St.
Boston	William L. Haines	161 Pearl St.
Boston	Henry S. Howe	68 Chauncy St.
Boston	William B. Kehew	24 Purchase St.
Boston	Evan Arthur Leigh	70 Kilby St.
Baston	William C. Lovering	40 Water St.
Boston	George A. Lowry	89 State St.
Boston	Herbert Lyman	95 Milk St.
Boston	Charles T. Main	1112 Exchange Building.
Boston	Fred C. McDuffie	40 Water St.
Boston	H. G. McKerrow	31 State St.
Boston	George H. Meader	35 Oliver St.
Boston	George B. Morison	95 Milk St.
Boston	William R. Noone	100 Pearl St.
Boston	Sidney B. Paine	180 Summer St.
Boston	Francis J. Parker	27 Kilby St.
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Charles F. Randall	350 Tremont Building.
Boston	Charles E. Riley	281 Congress St.
Boston	C. E. Roberts	125 Milk St.
Boston	Arnold B. Sanford	45 Milk St.
Boston	Henry B. Sawyer	45 Milk St.
Boston	J. Herbert Sawyer	45 Milk St.
Boston	H. T. Schaefer	5 Custom House St.
Boston	George H. Shapley	78 Chauncy St.
Boston	Willis S. Shepard	93 Commercial St.
Boston	William F. Sherman	27 State St.
Boston	Lewis R. Speare	369 Atlantic Ave.
Boston	Winthrop Thayer	1015 Tremont Building.
Boston	James P. Tolman	115 Congress St.
Boston	Charles D. Turnbull	The Ludlow.
Boston	Frank H. Underwood	137 Purchase St.
Boston	Erving Yale Woolley	152 Congress St.
Braintree	Horace L. Hayden	
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Canton Junction	Joseph W. Wattles	Manufacturers' Supplies.
Chicopee Falls	Henry A. Bailey	Chicopee Manufg. Co.
Clinton	William G. Nichols	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	George P. Taylor	

Clinton	George W. Weeks	
Easthampton	William O. Smith	Easthampton Spinning Co.
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Card Clothing Manufr.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Troy C. & W. Manufg. Co.
Fall River	Thomas J. Borden	Richard Borden Manufg. Co.
Fall River	George A. Chace	Bourne Mills.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	Simeon B. Chase	King Phillip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	B. D. Davol	Barnard Manufg. Co.
Fall River	David H. Dyer	7 and 8 Pocasset Bank Building.
Fall River	William Evans	Richard Borden Manufg. Co.
Fall River	John T. Fyans	411 Beach St.
Fall River	Daniel Gilligan	Pocasset & Metacomet Mills.
Fall River	John Gregson	Merchants Mfg. Co.
Fall River	A. M. Hamilton	Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160.
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	Samuel E. Hathaway	Fall River Iron Works Co.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	North Dighton Cotton Co.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co.
Fall River	Thomas Horsfield	465 Warren St.
Fall River	Edward B. Jennings	Globe Yarn Mills.
Fall River	Benjamin B. Kirk	2107 South Main St.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	John R. Mason	439 Middle St.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	William G. McLoon	Barnaby Manufg. Co.
Fall River	J. Edward Osborne	American Linen Co.
Fall River	Charles M. Shove	Granite Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	Albert A. Sweet	36 Rockland St.
Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	George F. Tryon	199 Purchase St.
Fiskdale	Oscar B. Truesdell	Fiskdale Mills.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	123 Myrtle Ave.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Warren M. Orswell	Orswell and Nockege Mills.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.

Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomspon	Parkhill Manufg. Co.
Great Barrington	Jno. H. C. Church	Monument Mills.
Griswoldville	James C. Deane	Griswoldville Manufg. Co.
Holyoke	Jones S. Davis	6 Newton Street.
Holyoke	John W. Dickinson	Lyman Mills.
Holyoke	Joseph M. Dunham	190 Walnut St.
Holyoke	Ernest Lovering	Lyman Mills.
Holyoke	C. W. Rider	Merrick Thread Co.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	William F. Draper, Jr.	Draper Co.
Housatonic	T. G. Ramsdell	Monument Mills.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	123 Hampden St.
Ipswich	James W. Brown	Box 312.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Eugene E. Burnham	168 Broadway.
Lawrence	Frederick E. Clarke	Pres. B. & L. R. R.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	217 Haverhill St.
Lawrence	Robert Redford	Arlington Mills.
Lawrence	Charles M. Sears	Atlantic Cotton Mills.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	George W. Towne	Arlington Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	Washington Mills Co.
Leicester	Charles A. Denny	American Card Clothing Co.
Linwood	Arba C. Slater	Linwood Mills.
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Christopher P. Brooks	The American Correspondence School of Textiles.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Machinery and Pulley Manufacturer.
Lowell	Clarence N. Childs	43 Pine St.
Lowell	Alonzo A. Coburn	Atherton Machine Co.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Albert W. Danforth	881 Bridge St.
Lowell	Edward P. Dennis	Lowell Machine Shop.
Lowell	C. E. W. Dow	67 Boott St.
Lowell	William A. Eastman	Lowell Hosiery Co.
Lowell	T. C. Entwistle	Cotton Machinery Builder.
Lowell	Frederick A. Flather	Lowell Machine Shop.

Lowell	Royal W. Gates	307 Market St.
Lowell	William E. Hall	Shaw Stocking Co.
Lowell	John H. Haworth	43 Columbus Ave.
Lowell	James G. Hill	749 Merrimack St.
Lowell	George L. Hooper	7 Belmont Street.
Lowell	Alvin S. Lyon	Lowell Manufg. Co.
Lowell	Roscoe S. Milliken	193 Mt. Hope St.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	Merrimac Manufg. Co.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	M. A. Rawlinson	Tremont & Suffolk Mills.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Edward W. Thomas	Tremont and Suffolk Mills.
Lowell	Charles T. Upton	Shaw Stocking Co.
Lowell	Jude C. Wadleigh	Mass. Cotton Mills.
Lowell	Frederick T. Walsh	Lowell Bleachery & Dye Works.
Lowell	Walter S. Watson	Haworth & Watson Manufg. Co.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lynn	C. J. H. Woodbury	Secy. and Treas.
Manchaug	Eben C. Willey	Manchaug Co.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Methuen	G. B. Emmons	Emmons Loom Harness Co.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Henry M. Wilcox	John Rhodes Warp Co.
Millbury	Theop. W. Wilmarth	Millbury Cotton Mills.
New Bedford	George A. Ayer	123 Fifth St.
New Bedford	Robert Burgess	Pierce Manufg. Corp.
New Bedford	Byron F. Card	Howland Mills.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	P. Y. DeNormandie	Potomska Mills.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Nathaniel B. Kerr	Grinnell Manufg. Corp.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	George H. Law	64 Willis St.
New Bedford	Stephen C. Lowe	87 Union St.
New Bedford	Andrew G. Pierce, Jr.	Rotch Spinning Co., Pierce Manufg. Corp. and Howland Mills Corp.
New Bedford	Herbert E. Walmesley	Wamsutta Mills.
New Bedford	William R. West	830 Purchase St.
Newton	Josiah G. Coburn	
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. P. Snelling	Saco and Pettee Machine Shops.
North Adams	Charles W. Dennett	Johnson Manufg. Co. and Dunbar Mills Co.

Northbridge	Henry S. Houghton, Jr.	Paul Whitin Manufg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
North Cambridge	Colin C. Bell	Laminar Fibre Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
North Uxbridge	Fred B. Whitin	Uxbridge Cotton Mills.
Oakdale	William B. Fittz	W. Boylston Manufg. Co.
Oakdale	Alfred N. Whiting	L. M. Harris Manufg. Co.
Pittsfield	L. C. Farnsworth	Farnsworth Card Clothing Co.
Reedville	George E. Spofford	Reedville Cotton Mills.
Salem	Alfred A. Hunting	26 Mason St.
Salem	William P. McMullen	Naumkeag Steam Cotton Co.
Salem	N. G. Simonds	Naumkeag Steam Cotton Co.
Saundersville	Thomas Wilmarth	Saunders Cotton Mills.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
South Hadley Falls	William R. Hill	Glasgow Manufg. Co.
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Taunton Machine Works.
Taunton	John J. Connell	Cohannet Mills.
Taunton	Peter H. Corr	38 Court St.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	P. T. Creed	Hopewell Mills.
Taunton	H. H. Culver	Elizabeth Poole Mill.
Taunton	Henry S. Culver	Westville Cotton Mill.
Taunton	Herbert Fisher	
Taunton	Abbott F. Lawrence	Nemasket Mills.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	William M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Nemasket Mills.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	Canoe River Mills.
Thorndike	Charles H. Hobbs	Thorndike Co.
Three Rivers	Roscius C. Newell	Palmer Mills.
Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Charles L. Bailey	Boston Manufg. Co.
Waltham	Charles E. Getchell	35 Willow St.
Ware	George E. Tucker	The Otis Co.
Webster	A. W. Brainerd	H. N. Slater Mills.
Webster	Ernest E. Clark	H. N. Slater Mills.
West Fitchburg	John Leiper	Fitchburg Manufg. Co.
Whitinsville	Alfred E. Adams	Linwood Mills.
Whitinsville	Josiah M. Lasell	The Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	The Whitinsville Machine Works.

Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Winchendon	Z. L. White	White Brothers.
Worcester	George Crompton	Crompton & Knowles Loom Works.
Worcester	Randolph Crompton	Crompton & Knowles Loom Works.
Worcester	Henry F. Harris	340 Main St.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works.
Worcester	F. H. Rice	394 Pleasant St.
Worcester	John M. Russell	Crompton & Knowles Loom Works.
Worcester	Justin A. Ware	Crompton & Knowles Loom Works.

RHODE ISLAND.

Albion	Andrew J. Currier	Albion & Valley Falls Co.
Allenton	R. A. Gray	Rodman Manufg. Co.
Ashton	Arthur H. Gulliver	Lonsdale Co.
Auburn	Albert F. Knight	
Bayside	Abel T. Atherton	Machine Maker.
Central Falls	Stephen L. Adams	Stafford Manufg. Co.
Central Falls	B. F. G. Linnell	P. O. Box 645.
Central Falls	O. B. Parker	U. S. Cotton Co.
Centreville	Harold Lawton	Warwick Mills.
Centreville	Robert B. Treat	Centreville Cotton Mills.
Crompton	C. T. Richmond	Crompton Co.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	Reynolds Manufg. Co.
Fiskville	James Gee	Interlaken Dye Works.
Georgiaville	Herbert R. Farnum	Bernon Mills.
Greenville	Reuben Pilling, Jr.	The Granite Mills Co.
Hamilton	Joseph Warren Greene	Hamilton Web Co.
Manville	Charles Henry Savage	Manville Co.
Manville	A. Tenny White	Manville Co.
Natick	Webster Knight	Natick Mills.
Pawtucket	William W. Blades	66 West Ave.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	John J. Hart	Charlton Manufg. Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	Ira J. Martin	62 Conant St.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	F. C. Sayles	Ponemah Mills.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Hope Co. and Phenix Mill.
Pontiac	W. H. Summersby	Pontiac Mill and Bleachery.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	47 Charles St.

Providence	H. C. Atwood	Williamsville Manufg. Co.
Providence	George R. Babbitt	182 South Water St.
Providence	Truman Beckwith	Dyerville Manufg. Co.
Providence	J. Frank Braids	212 Weybosset St.
Providence	D. Russell Brown	Butler Exchange.
Providence	H. Martin Brown	Butler Exchange.
Providence	E. C. Bucklin	Harris Manufg. Co. and Interlaken Mills.
Providence	Fred W. Bushnell	Narragansett Electric Light Co.
Providence	Charles H. Child	Butler Exchange.
Providence	Henry C. Clark	Standard Mill Supply Co.
Providence	Frank B. Comins	U. S. Aerophor Co.
Providence	Frederick I. Dana	Thomas Phillips Co.
Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co.
Providence	R. H. Deming	10 South Water St.
Providence	J. Herbert Foster	10 South Water St.
Providence	George A. Fuller	American Card Clothing Co.
Providence	William Gammell	Berkeley Co.
Providence	Rufus B. Goff	77 Exchange Place.
Providence	William B. Gowdey	40 Clifford St.
Providence	William S. Granger	Granger Foundry & Machine Co.
Providence	Henry T. Grant, Jr.	Mercantile Mutual Fire Ins. Co.
Providence	David Grove	610 Manton Avenue.
Providence	John H. Hambley	49 Westminster St.
Providence	A. Walter Harris	326 South Water St.
Providence	Elisha H. Howard	Harris Textile Co.
Providence	W. L. Hutchins	Crompron & Knowles Loom Works.
Providence	Joseph H. Kendrick	American Supply Co.
Providence	John M. Kimball	4 Market Sq.
Providence	Jesse A. Knight	Lawton Spring Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Charles W. Lippitt	Silver Spring B. & D. Co.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Mill Engineer.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	26 Olney St.
Providence	George C. Newell	17 Custom House St.
Providence	William C. Peirce	564 Eddy St.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Banigan Building.
Providence	Richard H. Rice	521 South Main St.
Providence	Louis E. Robinson	20 Market Square.
Providence	Frank P. Sheldon	Mill Engineer.
Providence	Harry M. Smith	77 Exchange Place.

Providence	Wilton H. Spencer	7 Exchange Place.
Providence	George W. Stafford	Crompton & Knowles Loom Works.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Edward P. Taft	Ponemah Mills.
Providence	Robert W. Taft	Coventry Co. and Bernon Mills.
Providence	Charles F. Taylor	Burgess Cop Tube Co.
Providence	D. M. Thompson	Corliss Steam Engine Co.
Providence	A. Curtis Tingley	7 Eddy St.
Providence	William P. Vaughan	Putnam Mfg. Co.
Providence	A. S. Winslow	P. O. Box 1494.
Quidnick	Albert Knight	Quidnick Mills.
Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen.
Riverpoint	C. Prescott Knight	Riverpoint Mills.
Slatersville	Charles F. Farrar	The Wm. A. Slater Mills Corp.
Slatersville	William P. Holt	The Wm. A. Slater Mills Corp.
Valley Falls	Arnold B. Chace, Jr.	Valley Falls Co. & Woonsocket Mills.
Valley Falls	Andrew J. Currier	Albion & Valley Falls Co.
Warren	Arnold Schaer	Warren Manufg. Co.
Warren	John Waterman	Warren Manufg. Co.
Westerly	J. H. Blades	Lorraine Manufg. Co.
Westerly	Louis L. Hohn	122 High St.
Westerly	W. Marshall Taylor	69 Mechanic St.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	Charles H. Gorton	Glenark Knitting Co.
Woonsocket	Frank Harris	Hamlet Mills.
Woonsocket	Henry S. Houghton, Sr.	65 Pond St.
Woonsocket	Albert C. Hoy	Hamlet Mills.
Woonsocket	Charles H. Merriman, Jr.	Globe Mill.
Woonsocket	William A. Robinson	Social Manufg. Co.
Woonsocket	Earl A. Thissell	Woonsocket Bobbin Co.
Woonsocket	Ariel C. Thomas	93 Clinton St.
Woonsocket	Charles E. Thomas	Forestdale Manufg. Co.

CONNECTICUT.

Baltic	Robert Rennie Taft	Baltic Power Co.
Danielson	James Herbert Smith	Quinebaug Co.
Hartford	William H. Stratton	95 Pearl St.
Jewett City	J. Colby Lewis	The Wm. A. Slater Mills Corp.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	A. A. Young, Jr.	Jewett City Mills.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	C. H. Truesdell	Attawaugan Co.
New Hartford	Robert R. Smith	Greenwoods Co.
New Haven	George S. Barnum	The Bigelow Co.
No. Grosvenor Dale	Frank M. Messenger	Grosvenor Dale Co.

Norwich	W. N. Blackstone	Attawaugan Co.
Norwich	W. R. Burnham	Universal Loom Co.
Norwich	C. H. Frisbie	Attawaugan Co.
Norwich	Marcellus Gould	Falls Co.
Norwich	W. G. Henderson	Shetucket Co.
Norwich	Moses Pierce	274 Broadway.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Uncasville	Charles D. White	Uncasville Manufg. Co.
Wauregan	James A. Atwood	Wauregan Mills & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Mills.
Willimantic	E. S. Boss	Willimantic Linen Co.
Willimantic	John Scott	Willimantic Linen Co.
Windsor Locks	J. R. Montgomery	J. R. Montgomery Co.

NEW YORK.

Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Cohoes	David S. Johnston	Cohoes Iron Foundry & Machine Co.
Cohoes	John E. Prest	Harmony Mills.
Hoosick Falls	O. W. Stites	
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	117 Duane St.
New York City	Edward R. Ballou	540 West 23rd St.
New York City	John W. Ferguson	253 Broadway.
New York City	Dudley T. Lyall	541 West 23rd St.
New York City	William L. Lyall	540 West 23rd St.
New York City	Arthur B. Mann	99 Franklin St.
New York City	Arthur Parkinson	13 Gold St.
New York City	Duncan D. Parmly	49 Wall St.
New York City	Vladimir P. Polevoy	120 Broadway.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
New York Mills, Oneida Co.,	Henry C. Phillips,	New York Mills.
Oswego	George H. Sayward	Standard Yarn Co.
Utica	George DeForest	Utica Steam Cotton Mills and Mohawk Valley Mills.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills.
Victory Mills	Joseph O. Hannum	Saratoga Victory Manufg. Co.

NEW JERSEY.

Garwood	William B. Munroe	
Gloucester City	Philip H. Fowler	
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.

Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Millville	John K. Russell	May's Landing Water Power Co.
Newark	William H. Loftus	Clark Thread Co.
Newton	Arthur W. Warren	

PENNSYLVANIA.

Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Chester	W. T. Galey	Aberfoyle Manufg. Co.
Lancaster	S. S. Spencer	Conestoga Steam Mills.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
Philadelphia	Robert Beatty	Coral and Adams Sts.
Philadelphia	T. Ashby Blythe	114 Chestnut St.
Philadelphia	Harry W. Butterworth	York & Cedar Sts.
Philadelphia	James Butterworth	York and Cedar Sts.
Philadelphia	Frederick A. Downes	925 Chestnut St.
Philadelphia	Edward W. France	Broad and Pine Sts.
Philadelphia	Merrill A. Furbush	224 Market St.
Philadelphia	Joshua Garsed	Wingohocking Mills, Frankford.
Philadelphia	H. S. Grove	218 Race St.
Philadelphia	W. C. Houston, Jr.	333 Drexel Building.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave. and 11th St.
Philadelphia	George Wood	626 Chestnut St.
Philadelphia	John P. Wood	521 North 22nd St.
Trainer	William E. Trainer	Linwood Mills.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.
Wilmington	Daniel Moore Bates, Jr.	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	James A. Gary	108 W. German St.

NORTH CAROLINA.

Asheville Spray	George A. Mebane	Asheville Cot. Mills. Spray Cotton Mills.
Charlotte	H. S. Chadwick	204 So. Tryon St.
Charlotte	C. W. Johnston	The Highland Park Mfg. Co.
Charlotte	R. M. Miller, Jr.	Atherton Mills.
Charlotte	E. A. Smith	Charlotte Supply Co.
Charlotte	D. A. Tompkins	Atherton Mills.
Charlotte	Wm. Whittam, Jr.	
Charlotte	J. P. Wilson	Dover Yarn Mills.

Greensboro	Edward T. Garsed	Hucomuga Mills.
Henrietta	Fred S. Mosher	Henrietta Mills.
Kings Mountain	Philip S. Baker	Crowders Mt. Cotton Mills.
Kings Mountain	F. Dilling	Dilling Cotton Mills.
Kings Mountain	C. E. Falls	Enterprise Mills.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Reidsville	John W. Arrington	Edna Cotton Mills.
Reidsville	James R. Pearce	Edna Cotton Mills.

SOUTH CAROLINA.

Columbia	Charles K. Oliver	Columbia Mills Co.
Columbia	W. B. Smith-Whaley	1328 Main St.
Fort Mills	John Gilligan	Fort Mills Mfg. Co.
Gaffney	H. D. Wheat	Gaffney Manufg. Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Newberry	Edward B. Wilbur	Newberry Cotton Mills.
Orangeburg	Arthur Whittam	The Enterprise Cotton Mills.
Orangeburg	Samuel Dibble	Enterprise Cotton Mills.
Pelzer	B. F. Guy	Pelzer Manufg. Co.
Pelzer	Ellison A. Smyth	Pelzer Manufg. Co.

GEORGIA.

Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Joel Smith	J. P. King Mfg. Co.
Augusta	George R. Stearns	Riverside Mills.
Columbus	E. N. Clemence	Eagle & Phenix Manufg. Co.
Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
La Grange,	Samuel Hale	Dixie Cotton Mills.
Lindale, Floyd Co.	Arthur W. Hunking	Mass. Mills in Georgia.
Macon	W. H. Richmond	Bibb Mill No. 2.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	Jerome Hill	8 Cotton Exchange Building.
Nashville	T. B. Dallas	Phenix Cotton Mills, Dallas Mfg. Co.
Nashville	Henry D. Martin	Tennessee Mfg. Co.

MISSOURI.

St. Louis	D. C. Ball	310 Merchants' Exchange.

LOUISIANA.

New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.

ALABAMA.

Cordova	Albert W. Dimick	Indian Head Mills.
Cordova	John R. Rostron	Indian Head Mills.
Huntsville	T. W. Pratt	West Huntsville Cotton Mills.

TEXAS.

Dickinson	Lawrence V. Elder	
Galveston	D. M. Ehrlich	Galveston Cotton Mills.
Waco	Jno. Hopkinson	Slayden & Kirksey Woolen Mills.

CANADA.

Province of Ontario.

Hamilton, Ont.	Charles Owen Dexter	Canadian Colored Cotton Mills Ltd.
Hamilton, Ont.	Farquharson J. Muir	Canadian Colored Cotton Mills Ltd.
Kingston, Ont.	Harry W. Kimball	

Province of Quebec.

Hochelaga, P. Q.	W. S. Hume	Dominion Cotton Mills, Ltd.
Montreal, P. Q.	Alfred Hawkesworth	Merchants Cotton Co.
Montreal, P. Q.	Fred Hawkesworth	Merchants Cotton Co.
Valleyfield, P. Q.	Fred Lacey	Montreal Cotton Co.
Valleyfield, P. Q.	Louis Simpson	Montreal Cotton Co.

NEW BRUNSWICK.

Marysville	John B. Cudlip	Gibson Cotton Mills.
Milltown	A. T. Malcolmson	St. Croix Cotton Co.
St. John	John H. Parks	Wm. Parks & Sons, Ltd.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	18
New Hampshire	26
Vermont	1
Massachusetts	258
Rhode Island	111
Connecticut	28
New York	21
New Jersey	7
Pennsylvania	19
Delaware	2
Maryland	1
North Carolina	17
South Carolina	11
Georgia	10
Kentucky	1
Tennessee	4
Missouri	1
Louisiana	1
Alabama	3
Texas	3
Province of Ontario	3
Province of Quebec	5
New Brunswick	3
	554

BACK NUMBERS OF TRANSACTIONS.

In response to numerous inquiries the Board of Government has directed that the price of the transactions of the Association to those who are not members shall be five dollars a copy.

Members can obtain back numbers for fifty cents a copy from Volnme 46 to and including Volume 60. For Volume 61 and later editions the price is one dollar per copy. It is preferred that money should accompany orders for back numbers.

The following cites the papers contained in the respective volumes, but does not include discussions and topical questions.

No. 46, Boston, Mass., April 24, 1889, Volume 46, Pages 97.

Application of Electro-motive Power to Mill Work.
W. S. KELLEY, Lowell, Mass.

The Sturtevant System of Heating, Ventilating and Moistening Textile Manufactories.
EUGENE N. FOSS, Boston, Mass.

The Barnard Vacuum System for Circulating Steam in Heating and Drying Coils.
CHARLES F. TARBELL, Boston, Mass.

No. 47, Boston, Mass., October 30, 1889, Volume 47, Pages 120.

Rope Driving.
LOUIS I. SEYMOUR, Plymouth, Mass.

Cost of Long Distance Electrical Power Transmission.
W. S. KELLEY, Lowell, Mass.

No. 48, Boston, Mass., April 30, 1890, Volume 48, Pages 43.

The Cohesive System of Building.
R. GUASTAVINO, Boston, Mass.

Moistening the Air in Mills.
W. V. WALLACE, Hinsdale, Mass.

No. 49, Boston, Mass., October 29, 1890, Volume 49, Pages 62.

The Manipulation of the Atmosphere in Mills for the Purpose of Charging the same with Moisture.
EMILE H. KLABER, Boston, Mass.

Temperature and Humidity; Atmospheric Changes Causing Loss and Gain in Cotton Fibre.
F. E. SAUNDERS, Lowell, Mass.

Transmission of Power by Manila or Cotton Ropes.
W. H. DODGE, Mishawaka, Ind.

Tests of Spindle Oils.
F. M. MESSENGER, North Grosvenor Dale, Conn.

No. 50, Boston, Mass., April 29, 1891, Volume 50, Pages 129.

The History of Spindles.
WILLIAM F. DRAPER, Hopedale, Mass.

Oil Fuel under Boilers.
CHARLES H. FISH, Manchester, N. H.

Electricity in Mill Work.
O. S. HUSSEY.

Food and Feeding Considered as a Factor in Making the Rate of Wages or Earnings.
EDWARD ATKINSON, Boston, Mass.

No. 51, Boston, Mass., October 28, 1891, Volume 51, Pages 60.

Methods of Preserving Timber in Situations which Expose It to Decay.
Col. JAMES FRANCIS, Lowell, Mass.

Wood Vulcanizing.
SAMUEL D. CRAFTS, Boston Mass.

Power and Speed in Cotton Mills.
FRANCIS P. SHELDON, Providence, R. I.

No. 52, Boston, Mass., April 27, 1892, Volume 52, Pages 63.

The Benefits Derived from the Licker-in and Shell-feed System to Cotton Cards.
E. W. THOMAS, Lowell, Mass.

Is the Production of a Mill Increased or Diminished by Stopping for Saturday Half-holidays?
F. M. MESSENGER, North Grosvenor Dale, Conn.

What is the best policy to pursue in manufacturing concerns having large quantities of similar machinery: whether to have one overseer over a large amount of work, or to distribute it among two or three overseers?
CHARLES D. MCDUFFIE, Manchester, N. H.

What has been the result of experience in bringing the power from engines or water wheels into the mill: at the end or in the centre, in mills of not less than 350 feet in length?
JOHN KILBURN, Lowell, Mass.

The use of single or double boss rolls on spinning frames: from which can be derived the most benefit?
WILLIAM J. KENT, New Bedford, Mass.

Tests of Spindle Oils.
A. M. GOODALE, Waltham, Mass.

The Life of Incandescent Lamps.
W. S. SOUTHWORTH, Lowell, Mass.

Picking as Applied to the English System of Carding.
ROBERT MCARTHUR, Biddeford, Me.

What is the best design for line-shafting transmitting over fifty horse-power, permitting stopping on any floor without interfering with the motor or with other shafting?
STEPHEN GREENE, Boston, Mass.

No. 53, Boston, Mass., October 26, 1892, Volume 53, Pages 94.

Tests of Spindle Oils.
A. M. GOODALE, Waltham, Mass.

The Life of Incandescent Lamps.
W. S. SOUTHWORTH, Lowell, Mass.

Picking as Applied to the English System of Carding.
ROBERT MCARTHUR, Biddeford, Me.

What is the best design for line-shafting transmitting over fifty horse-power, permitting stopping and starting on any floor without interfering with the motor or with other shafting?
STEPHEN GREENE, Boston, Mass.

Can the Dust Room of the Picker be done away with?
JOHN W. WELLS, Woodbury, N. J.
Electrical Transmission of Power for Cotton Mills.
C. J. H. WOODBURY, Lynn, Mass.

No. 54, Boston, Mass., April 26, 1893, Volume 54, Pages 84.

What is the best economy obtained from steam engines in cotton mills with actual examples and under varying conditions?
CHARLES H. MANNING, Manchester, N. H.
Moistening the Air in Cotton Mills.
NATHANIEL B. KERR, New Bedford, Mass.
Recent Developments in the Electrical Transmission of Power.
C. J. H. WOODBURY, Lynn, Mass.
Metallic Drawing Rolls.
H. L. PRATT, Lewiston, Me.
The Best Method of Heating a Cotton Mill.
CHARLES R. MAKEPEACE, Providence, R. I.

No. 55, Boston, Mass., October 25, 1893, Volume 55, Pages 64.

How may we Establish a Standard or Unit of Power for Cotton Mills?
F. M. MESSENGER, North Grosvenor Dale, Conn.
The Long Traverse and Large Ring as Applied to Spinning.
A. F. KNIGHT, Manchester, N. H.
Methods of Making Up Costs.
H. F. LIPPITT, Manville & Social Mfg. Co.
FRANKLIN NOURSE, York Mfg. Co.
R. W. EATON, Cabot Mfg. Co.
JOHN HOLLAND, Cochico Mfg. Co.
E. W. THOMAS, Tremont and Suffolk Mills.
W. J. KENT, Wamsutta Mills.
Mill Construction.
EDWARD ATKINSON, Boston, Mass.

No. 56, Boston, Mass., April 25, 1894, Volume 56, Pages 73.

Methods of Sizing Yarns.
GEORGE W. BEAN, Lewiston, Me.
Suggestions for a Standard Method of Making Up Costs.
A. M. GOODALE, Waltham, Mass.
HENRY F. LIPPITT, Providence, R. I.
E. W. THOMAS, Lowell, Mass.
WILLIAM J. KENT, New Bedford, Mass.
R. W. EATON, Brunswick, Me.

No. 57, Crawford House, N. H., Sept. 27, 28, 1894, Volume 57, Pages 230.

Proper Weights and Drafts from Pickers to Spinning Frames in Producing Nos. 28 and 36.

O. S. BROWN, Salmon Falls, N. H.
F. P. SHELDON, Providence, R. I.
W. F. SHERMAN, Lawrence, Mass.
STEPHEN GREENE, Boston, Mass.
JOHN W. PEAD, Lowell, Mass.
CHARLES T. MAIN, Boston, Mass.

Chemical Analysis of Sizing Compounds.

HENRY T. WHITIN, Northbridge, Mass.

The Holmes Fibre Graphite Bearing.

R. W. EATON, Brunswick, Me.

The Elementary Chemistry and Efficiency of the Storage Battery.

ALFRED CLARKE, Lowell, Mass.

Technical Textile Schools.

E. W. ATKINSON, Boston, Mass.

Humidity in Cotton Spinning.

B. A. DOBSON, Bolton, Lancashire, England.

No. 58, Providence, R. I., April 24, 25, 1895, Volume 58, Pages 310.

Vertical Engines for Cotton Mills.

RICHARD H. RICE, Rrovidence, R. I.

The Ideal Cotton Mill Steam Plant, Its Design and Management.

GEORGE C. ROCKWOOD, Worcester, Mass.

A Steam Creed.

Capt. CHARLES H. MANNING, U. S. N., Manchester, N. H.

Some Thoughts on the Economical Production of Steam with Special Reference to the Use of Cheap Fuel. By a Miner of Coal.

ECKLEY B. COXE, Drifton, Penn.

Water Power and Its Development as Connected with the Cotton Manufacture.

Col. SAMUEL WEBBER, Charlestown, N. H.

Water Power Development, and Its Cost.

A. C. RICE, Dayton, Ohio.

Electrical Driving of Textile Establishments.

SIDNEY B. PAINE, Boston, Mass.

Operating by Electricity from a Distance.

JOHN ECCLES, Taftville, Conn.

Generation and Distribution of Electric Power for Manufacturing Purposes.
C. A. STONE, Boston, Mass.
E. S. WEBSTER, Boston, Mass.

Equitable Payment of Prices for Weaving Various Styles of Goods.
E. W. THOMAS, Lowell, Mass.
A. F. KNIGHT, Manchester, N. H.

Humidifying and Ventilating Mills.
OTTO HOFFMAN, Manchester, England.

The Principles of Construction of Card Clothing.
JOSEPH NASMITH, Manchester, England.

No. 59, Atlanta, Ga., October 24, 25, 1895, Volume 56, Pages 298.

The Present Development of the Northrop Loom.
GEORGE OTIS DRAPER, Hopedale, Mass.

Improvement of Cotton.
EDWARD ATKINSON, Boston, Mass.

Cloth Calculations Simplified.
ARNOLD SCHAER, Warren, R. I.

An Improved Method of Preparing Cotton for Market.
W. E. ANDERSON, Little Rock, Ark.

Improvements in Baling and Handling Cotton.
D. C. BALL, St. Louis, Mo.

Baling and Compressing Cotton.
JEROME HILL, St. Louis, Mo.

Cotton Manufacturing Interests of the South.
RICHARD H. EDMONDS, Baltimore, Md.

Cotton Mill Building in the South.
W. B. SMITH-WHALEY, Columbia, S. C.

The Unmerchantable Method of Baling American Cotton.
Gen. STEPHEN M. WELD, Boston, Mass.

The Cultivation, Picking, Baling and Manufacturing of Cotton from a Southern Standpoint.
D. A. THOMPKINS, Charlotte, N. C.

Some of the Disadvantages Experienced by the Manufacturer through Poor Ginning and Baling of Cotton.
EDWARD W. THOMAS, Lowell, Mass.

The Relation of Employers and Employees in our Cotton Mills.
HERBERT E. WALMESLEY, Newark, N. J.

Sea Island Cotton.
ELIAS L. RIVERS, James Island, S. C.

No. 60, Boston, Mass., April 29, 30, 1896, Volume 60, Pages 269.

Dobby and Jacquard Weaving.
GEORGE W. STAFFORD, Providence, R. I.

Weave Shed Construction.
JAMES R. MACCOLL, Pawtucket, R. I.

The Northrop Loom.
FRANK M. MESSENGER, North Grosvenor Dale, Conn.

Cotton Manufacturing in Switzerland.
HERR TH. OTTO SCHWEITZER, Frauenfeld, Switzerland.

Technical Education in the Manufacture of Textiles.
EDWARD W. FRANCE, Philadelphia, Penn.

Public Textile Education in Massachusetts.
FRANK P. BENNETT, Boston, Mass.

The Future of Cotton Manufacturing in the South.
D. A. THOMPKINS, Charlotte, N. C.

No. 61, Profile House, N. H., September 22, 24, 1896, Volume 61, Pages 359.

Cotton Manufacturing in Japan.
Hon. ROBERT P. PORTER, Cleveland, Ohio.

The Manufacture of Fine Yarns.
HERBERT E. WALMESLEY, Newark, N. J.

The Use of the Comber in Cotton Manufacture.
E. W. ATKINSON, Boston, Mass.

Condensed Cotton Yarn and the Condenser Card.
CHRISTOPHER P. BROOKS, Charlotte, N. C.

Differential Motions for Spinning Machines.
JOSEPH NASMITH, Manchester, Eng.

What the Philadelphia Museum can do for the New England Cotton Manufacturers.
Prof. WILLIAM P. WILSON, Sc. D., Philadelphia, Pa.

Suggestions for the Future Work of the Association.
RUSSELL W. EATON, Brunswick, Me.

A Few Suggestions to Superintendents.
JOHN S. ADAMS, Jr., Adams, Mass.

Looms and Loom Fixers: Weavers and Weaving Rooms.
ALFRED HAWKESWORTH, Montreal, P. Q.

Power Tests on Gingham Looms.
GEORGE W. WEEKS, Clinton, Mass

Practical Theory of Steam Making from Shovel to Stop Valve.
WINTHROP THAYER, Boston, Mass.

The Heath Metallic Bale.
JOSEPH H. KENDRICK, Providence, R. I.

Power Transmission.
FRANK H. UNDERWOOD, Boston, Mass.

Economical Arrangements for Transportation of Cotton from Storehouse to Pickers, and from Weave Rooms to Cloth Hall.
EDWARD W. THOMAS, Lowell, Mass.

No. 62, Boston, Mass., April 28, 29, 1897, Volume 62, Pages 353.

The Handling and Transportation of Cotton.
STEPHEN A. KNIGHT, Providence, R. I.

Cotton Transportation from a Railroad Standpoint.
T. F. LEAVITT, Boston, Mass.
M. M. HURLEY, Louisville, Ky.
C. W. GIBSON, West Point, Miss.

The Round Bale and the New England Spinner.
D. C. BALL, St. Louis, Mo.

The Paul System of Drying.
HERBERT L. PRATT, Lewiston, Me.

The Lowell Textile School.
CHRISTOPHER P. BROOKS, Lowell, Mass.

The Manufacture and Use of Spinning Rings.
GEORGE A. DRAPER, Hopedale, Mass.

The Ring Traveler: Its History and Progress in the Spinning and Twisting of Yarns.
A. CURTIS TINGLEY, Providence, R. I.

Ring Spinning.
ALFRED E. ADAMS, Whitinsville, Mass.

Electricity for Mill Purposes.
FRANK P. SHELDON, Providence, R. I.

Recent Advances in Weaving.
WILLIAM G. NICHOLS, Clinton, Mass.

Weaving as a Fine Art.
ALFRED HAWKESWORTH, Montreal, Canada.

Picking and Carding.
MARCELLUS GOULD, Norwich, Conn.

The Management of Country Mills.
RUSSELL W. EATON, Brunswick, Me.

A Cotton Spinning Mill at Crefeld, Germany.
Department of State, Washington, D. C. Hon. PETER V. DEUSTER, U. S. Consul.

Early Days of the New England Cotton Manufacturers' Association.
Col. SAMUEL WEBBER, Charlestown, N. H.

No. 63, Philadelphia, Penn., October 27, 28, 1897, Volume 63, Pages 454.

The Importance of the Artistic Element in Textile Education.
EDWARD W. FRANCE, Director of Philadelphia Textile School, Philadelphia, Penn.

Modifications in Mill Design Resulting from Changes in Motive Power.
STEPHEN GREENE, Boston, Mass.

Power Testing on Frame Spindles.
GEORGE OTIS DRAPER, Hopedale, Mass.

Improved Methods of Drying.
JAMES A. WALSH, Lewiston, Me.

Old Style Carding *vs.* New Style Carding.
JOHN R. MASON, Fall Rlver, Mass.

The Purpose of Textile Education.
C. J. H. WOODBURY, Boston, Mass.

Movement and Statistics of Cotton Goods.
Prof. WILLIAM P. WILSON, Sc. D., Philadelphia, Penn.

The Manufacture and Export Trade of Cotton Goods.
ARTHUR PARKINSON, New York, N. Y.

Imports of Cotton Goods.
FRANK P. BENNETT, Boston, Mass.

Progress in Cotton Manufacturing in Russia.
VLADIMIR P. POLEVOY, New York, N. Y.

The Growth of the Modern Factory System.
ALFRED M. GOODALE, Boston, Mass.

The Cotton Yarn Preparation Department of the Lowell Textile School.
CHANNING WHITAKER, Lowell, Mass.

Philadelphia as a Manufacturing Centre.
CHARLES HEBER CLARK.

Comparative Life of Cotton Machinery and Valuations.
EDWARD W. THOMAS, Lowell, Mass.

Repair Shops.
FRANK M. MESSENGER, North Grosvenor Dale, Conn.

Mill Repair Shops.
D. D. DONOVAN, Providence, R. I.

The Proper Construction and Uses of Economizers.
HENRY G. BRINCKERHOFF, Boston, Mass.

Some Vital Points Concerning Fire Protection of Mill Property.
WILLIAM H. STRATTON, Hartford, Conn,

No. 64, Boston, Mass., April 27, 28, 1898, Volume 64, Pages 421.

Flax Culture and the Manufacture of Linens to take the Place of Coarser Cottons in New England.
JONES S. DAVIS, Holyoke, Mass.

The Prior Roller Cotton Gin.
THOMAS W. PRIOR, Philadelphia, Pa.

The Round Bale at the Mill.
STEPHEN N. BOURNE, Manchester, N. H.

One Hundred Years of Ginning and Baling Cotton.
GEORGE A. LOWRY, Boston, Mass.

The Excelsior Spinning Frame.
ABEL T. ATHERTON, Pawtucket, R. I.

Steaming Filling.
EDWARD A. MONGEON, Blackstone, Mass.

The Shuttle Shifting Loom.
RANDOLPH CROMPTON, Worcester, Mass.

Slashing.
GEORGE F. TRYON, Fall River, Mass.

The Bastard Reed for Cotton Weaving.
ARTHUR PARKINSON, New York, N. Y.

Our Export Trade in Cotton Goods.
CHRISTOPHER P. BROOKS, Lowell, Mass.

The Nicaragua Ship Canal.
GARDINER C. SIMS, Providence, R. I.

Cotton Yarn Mill Costs.
WILLIAM WHITTAM, Jr., Charlotte, N. C.

Early Inventions upon Copper Printing Rolls.
Col. SAMUEL WEBBER, Charlestown, N H.

What I Don't Know About a Cotton Mill.
MALCOLM CAMPBELL, Woonsocket, R. I.

No. 65, Crawford House, N. H., September 27-29, 1898, Volume 65.

The Linen Manufacture in New England: Its Possibilities and Its Limitations.
S. N. D. NORTH, Boston, Mass.

Mercerized Cotton.
J. R. MONTGOMERY, Windsor Locks, Conn.

Southern Cotton Mills and Manufacturing.
EDWARD B. WILBER, Newbury, S. C.

The Manufacture, Use and Care of Loom Harnesses and Reeds.
JOSEPH H. KENDRICK, Providence, R. I.

Cotton Grading and Mixing.
ARTHUR WHITTAM, Orangeburg, S. C.

Slasher Cylinder Bearings.
FREDERICK A. FLATHER, Lowell, Mass.

Different Values of Cotton Mills.
WILLIAM F. SHERMAN, Boston, Mass.

The Possibilities of a New Method of Drying Fabrics.
CHARLES H. FISH, Dover, N. H.

The Important Features Relating to Ring Spinning and the Cost of Supplies for Plain Looms.
ALFRED E. ADAMS, Whitinsville, Mass.

Some Advantages of the Cylindrical Lap Bale.
WILLIAM C. LOVERING, Boston, Mass.

The Early History of the Power Loom.
ALFRED M. GOODALE, Boston, Mass.

The Relations Between Steam and Water Power.
JAMES G. HILL, Lowell, Mass.

American Textiles at the Paris Exhibition of 1900.
JOHN H. MCGIBBONS, Director of Exhibits, Auditorium Building, Chicago, Ill.

ERRATUM.

In Transactions Volume No. 64 and pages 215 and 280 have O. B. PARKER read WALTER E. PARKER.

PROCEEDINGS.

In accordance with the legal notice the stated semi-annual meeting of the Association was held in the Crawford House, White Mountains, N. H., September 27-29, 1898. The following 122 members and guests were present.

ACTIVE MEMBERS.

ALFRED E. ADAMS, Whitinsville, Mass.
JOSEPH D. AIKEN, Taftville, Mass.
THOMAS ARMSTRONG, North Pownal, Vt.
CHARLES L. BAILEY, Waltham, Mass.
JOSEPH P. BATTLES, Boston, Mass.
JOHN BELL, Andover, Mass.
STEPHEN N. BOURNE, Manchester, N. H.
FRANK A. BOWEN, Lowell, Mass.
CHRISTOPHER P. BROOKS, Lowell, Mass.
FRANK B. COMINS, Providence, R. I.
JOHN J. CONNELL, Taunton, Mass.
ANDREW J. CURRIER, Valley Falls, R. I.
EDWARD P. DENNIS, Lowell, Mass.
CHARLES A. DENNY, Leicester, Mass.
GEORGE OTIS DRAPER, Hopedale, Mass.
JOSEPH M. DUNHAM, Holyoke, Mass.
JOHN ECCLES, Taftville, Conn.
CHARLES F. FARRAR, Slatersville, R. I.
FRANK S. FIELD, Shattuckville, Mass.

CHARLES H. FISH, Dover, N. H.
FREDERICK A. FLATHER, Lowell, Mass.
M. F. FOSTER, Millford, N. H.
ARTHUR H. GULLIVER, Ashton, R. I.
FRANK J. HALE, Newton Upper Falls, Mass.
JOHN F. HAMLET, Fall River, Mass.
WILLIAM B. HAWES, Fall River, Mass.
JAMES G. HILL, Lowell, Mass.
D. EDWIN IRVING, Chester, Penn.
EDWARD B. JENNINGS, Fall River, Mass.
JOSEPH H. KENDRICK, Providence, R. I.
STEPHEN A. KNIGHT, Providence, R. I.
WEBSTER KNIGHT, Providence, R. I.
FRED LACEY, Valleyfield, P. Q.
WILLIAM C. LOVERING, Boston, Mass.
THOMAS MAYOR, Providence, R. I.
JOHN TEMPEST MEATS, Taunton, Mass.
R. M. MILLER, Jr., Charlotte, N. C.
J. R. MONTGOMERY, Windsor Locks, Conn.
T. G. RAMSDELL, Housatonic, Mass.
CHARLES H. RICHARDSON, Clinton, Mass.
CHARLES M. SEARS, Lawrence, Mass.
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S. S. SPENCER, Lancaster, Pa.
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JAMES STRANG, Indian Orchard, Mass.

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Mrs. BENJAMIN ANTHONY, New Bedford, Mass.
Mrs. THOMAS ARMSTRONG, North Pownal, Vt.
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T. A. EMMONS, Lawrence, Mass.
Mrs. T. C. ENTWISTLE, Lowell, Mass.
Mrs. CHARLES H. FISH, Dover, N. H.
Mrs. MARY J. FISH, Taunton, Mass.
Mrs. FREDERICK A. FLATHER, Lowell, Mass.
Mrs. M. F. FOSTER, Millford, N. H.
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S. S. GOULD, Lowell, Mass.
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E. L. MERROW, Boston, Mass.
Mrs. R. M. MILLER, Jr., Charlotte, N. C.
Mrs. J. R. MONTGOMERY, Windsor Locks, Conn.
W. C. NAIRN, North Cambridge, Mass.
S. N. D. NORTH, Boston, Mass.
Mrs. S. N. D. NORTH, Boston, Mass.
GILBERT A. PHILLIPS, Providence, R. I.
AMASA PRATT, Lowell, Mass.
Mrs. AMASA PRATT, Lowell, Mass.
Mrs. T. G. RAMSDELL, Housatonic, Mass.
Mrs. CHARLES H. RICHARDSON, Clinton, Mass.
Mrs. JACOB ROGERS, Lowell, Mass.
Miss THEODORA SCHIRMEIER, St. Paul, Minn.
Mrs. E. L. SPARKS, Boston, Mass.
Mrs. S. S. SPENCER, Lancaster, Pa.
WILLIAM WELCH, Hopedale, Mass.
Mrs. WILLIAM WELCH, Hopedale, Mass.

FIRST SESSION.

CRAWFORD HOUSE, WHITE MOUNTAINS, N. H.,
Tuesday, Sept. 27, 1898.

Meeting called to order at 8 P. M., President STEPHEN A. KNIGHT in the chair.

The Secretary read the following call for the meeting:

BOSTON, MASS., August 8, 1898.

To the Members:

Notice is hereby given that the stated semi-annual meeting of the Association will be held at the Crawford House, White Mountains, beginning Tuesday evening, September 27, and continuing on the two following days. The first session will be called to order at 8 P. M., Tuesday, and the exercises will consist of the address by the President and the reading of one of the papers, after which the remainder of the evening will be devoted in a social manner to the renewal of old acquaintances and the formation of new ones.

The sessions Wednesday and Thursday will be held at 9 A. M. and 8 P. M., leaving the afternoon of each day free for excursions.

The detailed programme will be received by the members about one week before the meeting.

By order of the Board of Government,

C. J. H. WOODBURY,

Secretary.

The SECRETARY. In accordance with Article 14 of the by-laws I certify that this call was mailed to each member at least

ten days before the meeting and that a quorum is now present. The notice sent to members in full and the programme are as follows:

CALL TO SEMI-ANNUAL MEETING.

CRAWFORD HOUSE, N. H., SEPTEMBER 27-29, 1898.

NUMBER 65.

BOSTON, MASS., August 8, 1898.

To the Members:

Notice is hereby given that the stated semi-annual meeting of the Association will be held at the Crawford House, White Mountains, beginning Tuesday evening, September 27, and continuing on the two following days. The first session will be called to order at 8 P. M. Tuesday, and the exercises will consist of the address by the President and the reading of one of the papers, after which the remainder of the evening will be devoted in a social manner to the renewal of old acquaintances and the formation of new ones.

The sessions Wednesday and Thursday will be held at 9 A. M. and 8 P. M., leaving the afternoon of each day free for excursions.

The detailed programme will be received by the members about one week before the meeting.

By order of the Board of Government,

C. J. H. WOODBURY,

Secretary.

The arrangements for transportation have been placed in the hands of Messrs. Raymond & Whitcomb, Tourist Agents, 296 Washington Street, Boston, to whom all applications for tickets and correspondence on the subject of transportation should be directed.

The party will leave Boston on special Pullman drawing-room cars from the Union station, Causeway street, at 9.30 A. M. Tuesday, September 27, and pass through Lowell, Nashua, Manchester, Concord, etc., stopping at Plymounth, N. H., for dinner at the Pemigewasset House, and reaching the Crawford House at 5.30 P. M.

On the return trip, Friday, September 30, the party will leave the Crawford House at 9 A. M., on the route through the picturesque White

Mountain Notch, arriving in Boston *via* the Eastern division of the Boston & Maine Railroad at 3 P. M.

The return transportation tickets will be good for persons leaving for Boston at other times on any of the regular trains on the Eastern division of the Boston & Maine Railroad. Persons who desire to return directly to Lawrence or Lowell can leave the Boston train at Rochester, N. H. Those who go to the Crawford House from other parts of New England, or by other routes or other trains than the one on which the party leaves Boston, can make arrangements for rooms by applying to Messrs. Raymond & Whitcomb, and the same will be in readiness for their occupancy on their arrival at the hotel.

The entire cost of the trip, including railroad transportations both ways, Pullman car seats in the special cars both ways, dinner at Plymouth, and accommodations (room and board) at the Crawford House from Tuesday, including supper, until after breakfast on Friday, will be $17.00.

It is suggested that in applying for tickets members should indicate to Messrs. Raymond & Whitcomb any special desires they may have about grouping friends in the drawing-room cars, or in rooming at the hotel.

The privileges of the trip will be available to guests of members, including ladies.

The Board of Government consider it highly desirable that propositions for membership should be sent in as early as possible in advance of the meeting. Members will find blank propositions inside of the front page of the Transactions, or further copies will be sent on application.

Members who have overlooked their dues are kindly reminded to give the matter attention.

The paper on "Cotton Yarn Mill Costs," which was read by title at the Spring meeting, will be taken up for discussion, and printed copies will be distributed at the meeting and will be sent on application to any member.

PROGRAMME, MEETING NO. 65.

CRAWFORD HOUSE, N. H., SEPTEMBER 27-29, 1898.

First Session, Tuesday, September 27, 1898, at 8 P. M.

Call to Order.

Opening Address.

STEPHEN A. KNIGHT, President, Providence, R. I.

The Linen Manufacture in New England: Its Possibilities and Its Limitations.

S. N. D. NORTH, Boston, Mass.

The remainder of the evening will be devoted to an informal reunion of the members and guests.

Persons who are proposed for membership are especially invited to attend the meeting and to take part in the proceedings.

Second Session, Wednesday, September 28, 1898, at 9 A. M.

Discussion on Cotton Yarn Mill Costs.

WILLIAM WHITTAM, Jr., Charlotte, N. C.

Read by title at the 64th meeting.

Mercerized Cotton.

J. R. MONTGOMERY, Windsor Locks, Ct.

Southern Cotton Mills and Manufacturing.

EDWARD B. WILBUR, Newberry, S. C.

TOPICAL QUESTIONS.

92. Where is the economical range that ring filling frames may be used in competition with mules; that is, the lowest and highest number of yarn?

94. What is the best method of treating belts, and their proper care?

95. What is the best method of utilizing the waste products of a mill?

99. What is the best taper or length of wind for mule cops on No. 37 filling?

Third Session, Wednesday, September 28, 1898, at 8 P. M.

The Manufacture, Use and Care of Loom Harnesses and Reeds.

JOSEPH H. KENDRICK, Providence, R. I.

Cotton Grading and Mixing.

ARTHUR WHITTAM, Orangeburg, S. C.

Slasher Cylinder Bearings.

FREDERICK A. FLATHER, Lowell, Mass.

TOPICAL QUESTIONS.

100. Can ring frames be successfully employed as a substitute for twisters on fine numbers?

101. How much more than standard twist is it necessary to use in spinning frame filling to make satisfactory yarn, and make its use economical?

102. With modern picking machinery properly managed, revolving top flat cards and three processes drawing slubber and speeders; what are the finest numbers yarn one can with advantage spin before introducing intermediates; stock good middling one inch staple?

103. In what respects are ropes an advantage over belts for main driving?

Fourth Session, Thursday, September 29, 1898, at 9 A M.

Different Values of Cotton Mills.

WILLIAM F. SHERMAN, Boston, Mass.

The Possibilities of a New Method of Drying Fabrics.

CHARLES H. FISH, Dover, N. H.

The Important Features Relating to Ring Spinning and the Cost of Supplies for Plain Looms.

ALFRED E. ADAMS, Whitinsville, Mass.

TOPICAL QUESTIONS.

104. What is the best manner of putting up goods for Print Works and Bleacheries, and how should they be covered for protection in transit?

105. Are horizontal turbines an advantage over vertical turbines with heads below 18 feet?

106. In what respect is a vertical engine advantageous over a horizontal engine for driving cotton mills?

Fifth Session, Thursday, September 29, 1898 at 8 P. M.

Some Advantages of the Cylindrical Lap Bale.

WILLIAM C. LOVERING, Boston, Mass.

The Early History of the Power Loom.

ALFRED M. GOODALE, Boston, Mass.

The Relation of Steam to Water Power.

JAMES G. HILL, Lowell, Mass.

American Textiles at the Paris Exhibition of 1900.

JOHN H. MCGIBBONS, Director of Exhibits,
Auditorium Building, Chicago, Illinois.

TOPICAL QUESTIONS.

107. What is the superiority of iron beams over those of southern pine for mill floors?

108. What is the best method of coloring the inside walls of mills?

109. How can a card room be ventilated without undesirable currents of air?

110. What is the best way to keep mill hose for fire protection?

111. Are automatic sprinklers a necessity in the dust flues from pickers.

The records of the last meeting were read by the Secretary and accepted by vote duly seconded.

The SECRETARY. The Board of Government, in compliance with the preamble and resolutions on the subject of textile education, passed on the 64th meeting of the Association, April 28, 1898, recorded on page 96 of Volume 64 of the Transactions, have considered the subject and submit the following resolution for the consideration of the meeting:

"WHEREAS, The purpose of textile [manufacture is an art which requires the exercise of the highest types of proficiency throughout a wide range of engineering skill, artistic talent and administrative ability, all of which may be developed by suitable instruction, therefore be it

Resolved, That the New England Cotton Manufacturers' Association appreciates the great value of the advantageous training furnished by technical textile schools as an element contributing to the improvement of the product of mills and the methods of manufacture; and the establishment of such institutions should be encouraged wherever the conditions warrant an organization on a sufficiently broad basis to afford facilities for thorough instruction in the various processes of working and designing textiles."

On motion of Mr. STEPHEN N. BOURNE, duly seconded, it was voted that the resolutions reported by the Board of Government be accepted.

The Secretary read the following letter from his Excellency Hon. GEORGE A. RAMSDELL, Governor of the State of New Hampshire:

THE STATE OF NEW HAMPSHIRE.

EXECUTIVE DEPARTMENT.

CONCORD, 16 Sept., 1898.

C. J. H. WOODBURY, Secretary,
Boston, Mass.

My dear Sir:

I am in receipt of your courteous invitation to join the excursion of the New England Cotton Manufacturers' Association in their trip to the White Mountains September 27th.

It would give me pleasure to accept the invitation, but engagements of a public nature compel me to reluctantly decline it.

Your obedient servant,

GEORGE A. RAMSDELL.

PRESIDENT'S ADDRESS.

STEPHEN A. KNIGHT, Providence, R. I.

Ladies and gentlemen, guests and members of the New England Cotton Manufacturers' Association, I presume it would be in order for me to speak first of the grace and beauty that favor us with their presence tonight. Next, perhaps, it would be proper for me to speak, as is quite the custom, of the beautiful weather, but as the clouds hang over us tonight in a threatening manner, perhaps it would be as well to defer that until tomorrow. I will, however, say that I am glad to meet you all here tonight.

We have come together today to celebrate the 65th gathering of this society. In behalf of the Board of Directors, who have planned and arranged for the details of this meeting, I bid you all welcome; I bid you welcome to our discussions; I bid you welcome to these grand old hills, and to all the pleasures that accompany an outing of this nature.

It is now four years since this Association held its first Semi-Annual Meeting at the Crawford House. I think that meeting was the first that the Association had ever held outside the city of Boston, and the first meeting to which the ladies were invited. The fact that we have continued to hold our semi-annual meeting in localities apart from Boston, and to solicit and be honored with the attendance of the ladies, is a sufficient proof that that innovation was *not* a mistake.

It is an established fact that at any gathering where it is practical to admit ladies, it is *always* a mistake and *sometimes* a calamity to leave them out. We read that after God had created this beautiful world of ours, his next act was to make man. Then even He saw that it was not good for man to be alone, so

He immediately made woman for his helpmeet and companion, and from that day to this, she has proven herself to be a perfect success.

Many changes have taken place in our Association in these last four years; our membership has increased from 270 to 535, almost double, exclusive of those proposed for membership at the present meeting. The interest in the papers and discussions presented has kept pace with the increased membership, and today we hold a place in the estimation of the business public worthy the name of our Association. I trust we are not vain, but we *are* proud of our record.

Much yet needs to be done that it is possible for us to do. Let us not falter until the full measure of our ability is accomplished. Some of those who were "shining lights" in our midst when we last met here, have passed on to that better home, "where the weary are at rest." Others have come to take their places. Others will come to take our places when we fall. Will each of us strive so to do our part in this Association that when we have gone away it may be said, "He hath done all he could".

Our financial condition is better than four years ago, while our treasury is not overloaded, we have a small balance in our favor, and that balance would be improved if all dues were paid, and just here let me say while the annual assessment is small as compared with the value given in return, it would be gratifying to the Board of Government, and to our Treasurer, if each member would send in his dues as soon as practical after receiving notice from the Secretary. The usefulness of the Association could be materially enhanced if we had more funds. Even now we are in receipt of requests from two of our most valued members for an appropriation for experiments that would doubtless prove of great value. Our records of Transactions have been greatly improved and enlarged and they alone are fully worth the amount of our annual assessments. Our Secretary informs me that our Association is the only technical organization in this country issuing transactions of their own, in which the dues

are as low as five dollars. Our board meetings have been frequent and well attended, and the interest of our Association is ever uppermost and duly considered at these meetings. Papers and topical questions are fully considered and arranged in their most presentable form, and I am sure the success or non-success of our meetings depends largely upon the deliberation and thoughtful considerations of our Board of Directors.

The business that this Association represents has in the last three years realized a depression such as has never before been felt since the cotton industry was established in our country. There are many theories as to the cause of this depression. It is a wise man that can name them all or that can show us the way out of our present discouraging dilemma.

Since our last meeting, we have been at war with the Kingdom of Spain. It was a war in the interest of humanity; a war for human rights; a war to break the thraldom of tyranny, oppression and degradation of a multitude of human beings. Under the guiding and protecting care of the great Ruler of the Universe, our noble, brave and skilful navy and armies have fought and won battles and victories such as the world had never known. Our flag — the stars and stripes — the red, white and blue — the proudest and most glorious flag ever thrown to the breezes of Heaven, has maintained its honor and covered itself anew with glory. It has proclaimed to all the world that it must not, that it cannot, be insulted with impunity.

As a result of the war, we have acquired new territories and a new people, and when the questions are all fully settled, shall have added many thousands of naked, poorly fed and totally neglected human beings to our care and protection. All this great mass of people must be civilized, fed and clothed, and in exchange for their commodities we can in a measure pay them with the product of our manufactories. Let us hope that this and other causes will give new confidence and new life to trade, that our spindles may hum anew, all our people be employed, and the old-time prosperity come again to cheer our hearts.

A word in regard to our semi-annual meetings. As before

stated our first out of Boston meeting was held at this house and it was the general verdict at that time that we made no mistake in coming here. We were given the full use of the house, our rooms were clean and orderly, our beds were good, and a table that might "tempt the gods". The next year we went by invitation to Atlanta, Georgia. To say that we were royally entertained only faintly expresses it for the time being the city and all that it contained was turned over to us. It was a grand gala day from the time we entered until we left the city; a visit never to be forgotten by those of us who were so fortunate as to be there. The next meeting was at the Profile House, N. H. And the following year by special request we went to Philadelphia — *What ought I to say? What can I say* of that meeting? Words fail to convey a correct description of our reception and entertainment while there. *It was just simply grand.* I have not forgotten that one of our Spring meetings was held in Providence, R. I. As I am a citizen of that city and was one of the committee of arrangements, modesty forbids that I should say only what many at that time said to me, "It was not a mistake to put our trust in Providence."

So now we have come again to the mountains. There were various reasons for our doing so. In the first place, we felt that we ought this year to seek some place where all the members of the Association could afford the time and expense to attend, and where we could get a hundred cents on the dollar for all we put out. Past experience told us that was to be had here. Another reason was, that here we could all be under one roof, all dine in one hall — in short, to meet as one family. To get better acquainted with each other, to tell one another of our joys and woes. Unfortunately just now more woes than joys. Here we can see so much of the beauties of nature, these majestic old mountains, these lovely dales, these beautiful cascades, the trickling streams and the babbling brook, and last but not least, this well kept house and grounds.

Many years ago before the great storm that occurred June 20, 1883, had washed the mountain sides, causing great landslides,

and carried away the wonderful boulder at the flume, an honest farmer from Vermont, after the haying was over, felt the need of a few days' rest. So he took his good wife, the boys and the girls for a trip to that famous resort. When he reached the entrance to the grounds a little boy met him and reaching out his tiny hand said "*Toll, please, sir*". The farmer opened his eyes with astonishment and exclaimed "*Toll?*" The little boy still held out his hand and repeated "*Toll, please, sir!*" "Did'nt God Almighty make these mountains?" inquired the farmer. "Yes, sir, I suppose He did," said the lad, "but Taft and Greenleaf built this road". "*Toll, if you please, sir!*"

So here God did create these lofty mountains, these lovely valleys, these beautiful cascades, these trickling streams and the babbling brooks. But it was left for Barron & Merrill to furnish us with shelter and food and provide for all our immediate wants. *It could not have been left in better hands.*

We have arranged our meetings so as to take only a part of each day. I am going to ask each of you to give us as much of your time at the meetings as you can, and for every member to take an active part in the discussion of papers and topical questions. There will be special facilities for visiting the various places of interest and when we are ready to go to our homes, I hope every one can honestly say they are glad they came.

The following paper was read:

The Linen Manufacture in New England: Its Possibilities and Its Limitations.

S. N. D. NORTH, Boston, Mass.

Discussed by Messrs. PERCY H. BRUNDAGE of New York, JOHN BELL and Col. SAMUEL WEBBER.

The remainder of the evening was devoted to an informal reunion of members and guests, which was rendered especially enjoyable by the Crawford House orchestra under the direction of Mr. E. D. MARBLE.

SECOND SESSION.

WEDNESDAY, SEPTEMBER 28, 1898.

Meeting called to order at 9 A. M., President KNIGHT in the chair.

The following papers were read and topical questions discussed:

Discussion on Cotton Yarn Mill Costs.

WILLIAM WHITTAM, Jr., Charlotte, N. C.

Read by title at the 64th meeting.

Discussed by Messrs. C. J. H. WOODBURY, STEPHEN N. BOURNE, WILLIAM. B. HAWES, LOUIS SIMPSON, STEPHEN A. KNIGHT and JOHN ECCLES.

Mercerized Cotton.

J. R. MONTGOMERY, Windsor Locks, Ct.

Discussed by Messrs. FRED LACEY, JOHN ECCLES, PERCY H. BRUNDAGE, JOHN BELL, LOUIS SIMPSON, FREDERICK A. FLATHER and STEPHEN A. KNIGHT.

Southern Cotton Mills and Manufacturing.

EDWARD B. WILBUR, Newberry, S. C.

Discussed by Messrs. R. M. MILLER, Jr., STEPHEN N.

BOURNE, Col. JOSEPH H. KENDRICK, Capt. JAMES G. HILL and JOHN ECCLES.

TOPICAL QUESTIONS.

92. Where is the economical range that ring filling frames may be used in competition with mules; that is, the lowest and highest number of yarn?

Discussed by Messrs. LOUIS SIMPSON, JOHN ECCLES and ARTHUR H. GULLIVER.

94. What is the best method of treating belts, and their proper care?

No discussion.

95. What is the best method of utilizing the waste products of a mill?

Discussed by Messrs. JOHN ECCLES, STEPHEN N. BOURNE, Col. JOSEPH H. KENDRICK, C. J. H. WOODBURY and FREDERICK A. FLATHER.

99. What is the best taper or length of wind for mule cops on No. 37 filling?

Discussed by Messrs. JOHN ECCLES and JOHN TEMPEST MEATS.

THIRD SESSION.

WEDNESDAY, SEPTEMBER 28, 1898.

Meeting called to order at 8 P. M., President KNIGHT in the chair.

The PRESIDENT. The time has arrived for the business of the meeting. Our first business will be to listen to some remarks from Mr. WILLIAM W. CROSBY, Director of the Lowell Textile School.

Mr. WILLIAM W. CROSBY. Mr. President, ladies and gentlemen, the President and Secretary have been good enough to allow me to say a word here in behalf of the Textile School at Lowell. The school, as you know, is under way, the reports of its supposed state of non-existence to the contrary notwithstanding, although the management has changed during the past summer. The larger number of lecturers and instructors has been retained, however, and the school programme is prepared for another year. We have received numerous gifts of machinery during the summer, not so much of interest to this Association, perhaps, as to the gentlemen who will meet later in the year, the increase having been principally in the Woolen and Worsted departments. Our Cotton Department is now quite complete; the Wool and Worsted departments still lack a comb, but that is, we hope, not to be wanted long; the Department of General

Chemistry is entirely equipped; that of Dyeing is still is a state of construction, but enough has been done to enable us to have regular second year work in that branch. Our Art and Design Department require, of course, but little other than room, in the way of equipment, but if our classes increase very much this year, we will need quite a little more space.

Last year I had the honor of conducting a department in the school work, so that I have had a very good chance to see the necessity of keeping pace with the demands made upon the school. Nearly every resource was drawn upon, then, and it looks this year as if we would have to do not a little planning to keep pace with the demands that are liable to be made upon us, for we have students of a third year class to plan for.

Our courses now are numbered, I, Cotton Manufacture; II, Woolen and Worsted Manufacture; III, Designing; IV, Chemistry and Dyeing.

This does not mean that a man who selects Cotton Spinning is taught no Chemistry or Dyeing; he takes the general work in this, as well as a general course in Designing, but make a speciality of cotton. Students who choose Cotton are not given any instruction in Wool Manufacturing, or *vise versa*, but Chemistry, we believe, is of great importance to know. But I am not here to impress you with the great utility of the school, rather to interest you in it, and to invite you, when you are in Lowell to make us a visit; if any special problems of an experimental nature suggest themselves to you, I would be glad if you would communicate with us, and let us help the trade in whatever way we can.

The PRESIDENT. Mr. GRANGER of Providence has something that he would like to say to the Association.

Mr. WILLIAM S. GRANGER. Mr. President, ladies and gentlemen, at the present time all cotton manufacturers especially are interested in finding some way to dispose of their surplus in cotton goods. The Textile Museum of Philadelphia has com-

menced a good work, but I do not think it will carry it half far enough, and I believe the only and the best way is through the medium of this Association. We have, I understand, about 18,000,000 spindles in this country; England has 45,000,000. While I do not expect to, there are many here who will live to see 45,000,000 spindles in cotton in this country. The question arises, how shall this surplus be disposed of? We have today, say, 75,000,000 inhabitants; 25 years from this time we shall probably have from 115,000,000 to 120,000,000; but for all that we must have an export. Where shall this increase of spindles be located? Principally, I think, at the South. The two able papers that have been read here today, one in regard to the mercerizing of cotton and one in regard to the mills at the South, have thrown light on some of these great problems, as have the discussions and the remarks made for and against the improvements and upon the prospects of the manufacturers of cotton goods at the South. But I think at the North the manufacture of cotton goods of the finer grade is continuing to increase; in other words, all the spindles in the New England states must manufacture that class of goods that requires the least amount of raw material and the greatest amount of skilled labor. To be sure, at the present time there is a large quantity of fine goods manufactured here at the North, which the dear ladies — God bless them — buy as imported goods; and I hope the time will soon come, in view of the skill and industry and perseverance of the manufacturers here in the North, any lady who sees the word "America" branded on the goods will take them in preference to foreign. Nations, like men, change rapidly; the wheel of fortune has turned completely. It has turned now in our favor. The war between Japan and China opened to a certain extent the channels of trade — an entering wedge, merely — into China with her 300,000,000 or 400,000,000 inhabitants. Now follow the Philippine Islands, with their 10,000,000 inhabitants, and Cuba and Porto Rico with a smaller amount. They are to be supplied with cotton goods. It seems to me that with our small amount of trade and the large amount

of trade of foreign countries, there ought to be a sufficient ability to take our share of the goods that will be manufactured in the future. The methods of England in transacting her foreign business are good, far better than ours. She has her lines of vessels and her trained diplomats in different countries; we should have the same. But I think that attention ought to be paid largely to this field for disposing of our goods. As I say, I know of no other way than through this organization. I, therefore, present my motion that the Board of Government have power to appoint a committee to consider this subject and to report at some future meeting.

The PRESIDENT. Gentlemen, you hear the motion of Mr. GRANGER. Are there any remarks to be made upon it?

Mr. THOMAS G. COX. I second that motion, Mr. President.

Mr. WILLIAM S. GRANGER. Mr. President, I would like to hear some remarks from other gentlemen here who are largely interested in cotton manufacture, and get their ideas.

The PRESIDENT. The matter is open for discussion if any one has any remarks to make.

Mr. THOMAS G. COX. Mr. President, I would like to make a remark or two in regard to that. Having had an experience of about two years in South America, I was very much impressed while there with the persistence of the European manufacturers in sending men down to those South and Central American countries to sell their products; and one of the most important things that American manufacturers have yet to learn is the putting up goods in such a shape that people in those countries will buy them. I think that a committee to be appointed by the Board of Government can investigate the matter carefully, and to the great advantage of the members of the Association.

The motion was put to vote and carried unanimously.

The following papers were read and topical questions discussed:

The Manufacture, Use and Care of Loom Harnesses and Reeds.
JOSEPH H. KENDRICK, Providence, R. I.

No discussion.

Cotton Grading and Mixing.
ARTHUR WHITTAM, Orangeburg, S. C.

Discussed by Mr. JOSEPH M. DUNHAM.

Slasher Cylinder Bearings.
FREDERICK A. FLATHER, Lowell, Mass.

No discussion.

TOPICAL QUESTIONS.

100. Can ring frames be successfully employed as a substitute for twisters on fine numbers?

Discussed by Messrs. JOSEPH M. DUNHAM, STEPHEN A. KNIGHT, LOUIS SIMPSON, WILLIAM WELSH, D. EDWIN IRVING, CHARLES H. RICHARDSON, CHARLES H. FISH and THOMAS MAYOR.

101. How much more than standard twist is it necessary to use in spinning frame filling to make satisfactory yarn, and make its use economical?

Discussed by Messrs. ALFRED E. ADAMS, LOUIS SIMPSON, CHARLES H. RICHARDSON and ARTHUR H. GULLIVER.

Mr. LOUIS SIMPSON. Before we close I would like to make a suggestion, and that is as to the place of meeting for next year. I would like the members of our Association to consider the advisability of coming to Montreal. I think they would find it very convenient to go to Montreal. In that part of Canada there are several new mills being built, and there are more developments of water power than within a short distance of any

other place in the country. I think the members would find the visit very useful; therefore I hope they will consider this question and be ready to vote on it tomorrow. [Applause.]

Mr. STEPHEN N. BOURNE. I hope the members will look favorably on going to Montreal. I had the pleasure of going there once. If we go to Montreal we will have just as good a time as we had in the South.

At the conclusion of the meeting the members were entertained by songs by Mrs. PAULINE H. CLARK of Boston, with Miss LEIDA LOW of Boston, accompanist.

FOURTH SESSION.

THURSDAY, SEPTEMBER 29, 1898.

Meeting called to order at 9 A. M., President KNIGHT in the chair.

The SECRETARY. The Board of Government present with their approval the following names of candidates for membership:

FOR ACTIVE MEMBERSHIP.

ISAAC A. BROWN, Treasurer Narragansett Mills, Fall River, Mass.
By Mr. GEORGE A. CHACE.

WILLIAM W. CRAPO, President Wamsutta Mills, New Bedford, Mass.
By Mr. C. J. H. WOODBURY.

PHILIP DANA, Superintendent Dana Warp Mills, Westbrook, Me.
By Mr. WOODBURY K. DANA.

SAMUEL DIBBLE, President Enterprise Cotton Mills, Orangeburg, S. C.
By Mr. ARTHUR WHITTAM.

JOHN GILLIGAN, Manager Fort Mills Manufacturing Co., Fort Mills, S. C.
By Mr. WILLIAM WHITTAM, Jr.

EDWARD B. JENNINGS, Treasurer Globe Yarn Mills, Fall River, Mass.
By Mr. WILLIAM B. HAWES.

C. PRESCOTT KNIGHT, Manager River Point Mills, River Point, R. I.
By Mr. STEPHEN A. KNIGHT.

WEBSTER KNIGHT, Manager Natick Mills, Natick, R. I.
By Mr. STEPHEN A. KNIGHT.

R. M. MILLER, Jr., Vice President The Atherton Mills, Charlotte, N. C.
By Mr. T. G. COX.

WILLIAM C. LOVERING, President Whittenton Manufacturing Co., 40 Water St., Boston.
By Mr. C. J. H. WOODBURY.

J. R. MONTGOMERY, President the J. R. Montgomery Co., Windsor Locks, Conn.
By Mr. T. G. RAMSDELL.

BENJAMIN PHIPPS, Treasurer Clarendon Mills, 4 Winthrop Sq., Boston.
By Mr. C. J. H. WOODBURY.

JOHN R. ROSTRON, Superintendent Indian Head Mills of Alabama, Cordova, Ala.
By Mr. A. W. DIMICK.

WILLIAM P. VAUGHAN, Agent Putnam Manufacturing Co., Providence, R. I.
By Col. J. H. KENDRICK.

FOR ASSOCIATE MEMBERSHIP.

FRED W. BUSHNELL, Mechanical Superintendent Narragansett Electric Light Co., Providence, R. I.
By Mr. F. P. SHELDON.

JAMES H. KENDALL, of Edward Kendall & Sons, Cambridgeport, Mass.
By Mr. S. A. KNIGHT.

GEORGE C. NEWELL, of Starkweather & Shepley, 17 Custom House St., Providence, R. I.
By Mr. A. WALTER HARRIS.

H. T. SCHAEFER, Sterling Coal Co., 5 Custom House St., Boston.
By Mr. FRANK B. COMINS.

The President appointed Mr. LOUIS SIMPSON, Col. JOSEPH H. KENDRICK and Mr. THOMAS G. COX a committee to distribute, collect and count ballots, who reported later that they had attended to their duty and that each of the names had received unanimous election.

The PRESIDENT. I declare that the gentlemen whose names are upon the ballot have been unanimously elected members of the New England Cotton Manufacturers' Association.

TOPICAL QUESTIONS.

102. With modern picking machinery properly managed, revolving top flat cards and three processes drawing slubber and speeders; what are the finest numbers yarn one can with advantage spin before introducing intermediates; stock good middling one inch staple?

No discussion.

103. In what respects are ropes an advantage over belts for main driving?

Discussed by Messrs. FRANK H. UNDERWOOD, STEPHEN N. BOURNE, LOUIS SIMPSON and STEPHEN A. KNIGHT.

Different Values of Cotton Mills.

WILLIAM F. SHERMAN, Boston, Mass.

No discussion.

The Possibilities of a New Method of Drying Fabrics.

CHARLES H. FISH, Dover, N. H.

Discussed by Messrs. WILLIAM S. GRANGER, LOUIS SIMPSON, FREDERICK A. FLATHER and STEPHEN N. BOURNE.

The Important Features Relating to Ring Spinning and the Cost of Supplies for Plain Looms.

ALFRED E. ADAMS, Whitinsville, Mass.

Discussed by Messrs. GEORGE OTIS DRAPER, FREDERICK A. FLATHER and STEPHEN A. KNIGHT.

TOPICAL QUESTIONS.

104. What is the best manner of putting up goods for Print Works and Bleacheries, and how should they be covered for protection in transit?

Discussed by Messrs. CHARLES H. FISH, STEPHEN N. BOURNE and STEPHEN A. KNIGHT.

105. Are horizontal turbines an advantage over vertical turbines with heads below 18 feet?

Discussed by Col. SAMUEL WEBBER, Capt. JAMES G. HILL and Mr. FRANK A. BOWEN.

106. In what respect is a vertical engine advantageous over a horizontal engine for driving cotton mills?

Discussed by Mr. THOMAS ARMSTRONG.

FIFTH SESSION.

THURSDAY EVENING, SEPTEMBER 29, 1898.

Meeting called to order at 8 P. M., President KNIGHT in the chair.

The PRESIDENT. Ladies and gentlemen, the first business of the evening will be to listen to a resolution which Mr. SIMPSON of Montreal wishes to bring before the meeting.

Mr. LOUIS SIMPSON. Mr. President, last evening I intimated that it was my wish today to place before the Association a resolution. It is as follows:

Resolved, That it is, in the opinion of this meeting, desirable that the next semi-annual meeting of this Association be held in Montreal, and that the Board of Government is hereby requested to give its favorable consideration to this resolution.

I may say, Mr. President, that if the Board of Government sees fit in its wisdom to select Montreal as the place of the next semi-annual meeting of the Association in the Autumn, it will be a pleasure to the Montreal people to do their best to make it pleasant in every respect; at the same time, we cannot expect in any way to rival the meeting that was held in Philadelphia. We are only a small people, but out of our good will we will do the best we can for you, and we hope if you come there we will send you home both happier and wiser. [Applause.]

The PRESIDENT. The Association, of course, understands that this matter is a matter that is settled by the Board of Government during the coming year as to the place at which the next meeting of the Association shall be held, and Mr. SIMPSON'S motion is that it is the sense of this meeting that our Board of Government shall give the matter of meeting in Montreal next Autumn its favorable consideration. Mr. SIMPSON makes the motion; does anybody second it?

Mr. STEPHEN N. BOURNE. I second the motion.

The question being put to vote, the resolution was unanimously adopted.

The SECRETARY. Mr. President, I have received the following letter from Mr. M. A. FURBUSH, whom many of you will remember at Philadelphia a year ago as a man whose skill, taste and activity infused every element of the arrangements of the local committee, which was such a perfect piece of organization and entertainment:

PHILADELPHIA, Sept. 27, 1898.

C. J. H. WOODBURY, Esq.,
Sec'y New England Cotton Mfrs. Association.
Crawford House, White Mountains, N. H.

Dear Sir:

It was with great regret that I was obliged to telegraph you last evening that it would be impossible for me to attend your semi-annual meeting, to be held at the Crawford House, Sept. 27, 28 and 29, 1898.

I had planned and hoped to go, and in fact had the tickets purchased, but circumstances arose which rendered my attendance impossible.

I endeavored to induce as large a representation as possible from the small membership which the Association has in the state of Pennsylvania and I regret that only a few of the members were able to go. It was on this account as well as to show my appreciation for the very large New England attendance last year when the Association held its meeting in our city, that I was particularly anxious to be present.

Very respectfully yours,

M. A. FURBUSH.

Some Advantages of the Cylindrical Lap Bale.

WILLIAM C. LOVERING, Boston, Mass.

Discussed by Messrs. JOSEPH M. DUNHAM, LOUIS SIMPSON, CHARLES H. FISH, STEPHEN N. BOURNE, and J. R. MONTGOMERY.

The Early History of the Power Loom.

ALFRED M. GOODALE, Boston, Mass.

Read by title.

The Relation of Steam to Water Power.

JAMES G. HILL, Lowell, Mass.

No discussion.

American Textiles at the Paris Exhibition of 1900.

JOHN H. MCGIBBONS, Director of Exhibits,
Auditorium Building, Chicago, Ill.

Mr. CHARLES H. FISH. I move that the suggestion for a joint cotton exhibit contained in this paper be referred to our Board of Government for action.

The motion, being duly seconded, was put to vote and carried.

Consideration of the following topical questions was postponed to a future meeting:

107. What is the superiority of iron beams over those of southern pine for mill floors?

108. What is the best method of coloring the inside walls of mills?

109. How can a card room be ventilated without undesirable currents of air?

110. What is the best way to keep mill hose for fire protection?

111. Are automatic sprinklers a necessity in the dust flues from pickers?

The PRESIDENT. We have consumed so much of the evening that we have thought best that the few topical questions remaining on the programme should be left over until another meeting. I simply wish to say that for myself and in behalf of the Board of Government I extend thanks to the members present for their very liberal attention and attendance. It has been a source of great pleasure to your President to find so many of you present and find so careful attention given to the papers, and that so many have participated in the discussions. It is an evidence that the interest in the Association is rapidly growing, and I trust that at our future meetings we may have larger gatherings, and I am sure that the Board of Government will prepare for you the best material within their power, and for the future we hope, as has already been stated, that all of the members of this Association will prepare themselves and come to the meetings with the intention of taking active part in the discussion of the papers. That is really what makes our meetings more interesting than they have been in the past. That disposition has seemed to grow upon the Society. It is very gratifying to us all, and I hope it will still continue to grow. I thank you, ladies and gentlemen, for the indulgence that you have given to your President, and for the remainder of my term I will endeavor to do the best that within me lies. Before the audience disperses our Secretary has a few notices that he would like to give.

The SECRETARY. Mr. President, the agents of Messrs. Raymond & Whitcomb wish me to announce to you that the train returning to Boston will leave at 9.22 tomorrow morning, but they would like to have the baggage set out at their disposal at half past seven.

There have been a number of requests for complete sets of the advance copies of papers which have been printed, some in great haste, and it is but a matter of justice to the authors to make reminder of the notice at the head of the copies that they are all subject to author's revision for the elimination of typographical errors. They are in a row upon the piano, for you to make your

selection for yourselves and your friends; and after that selection has been made I trust that the authors will take what copies are left, because in every such instance there are a great many requests for copies of papers directly to the authors.

I also trust that the gentlemen who have participated in the discussions will further give me their co-operation in the prompt return of the proof, because, as the books are made up page after page, undue delay of any one speaker in the correction of the proof prevents the issuing of the rest of the work.

The Association has been changing to new rooms for headquarters during this meeting, and after this time they will be in the International Trust Building at 45 Milk St., corner of Devonshire St., Room 57, on the fifth floor.

These are a few surplus badges on the table, and as some of you would like them as souvenirs for others, and I trust you will remember some of your friends and colleagues, if you think it would interest them, by helping yourselves.

The PRESIDENT. The 65th semi-annual meeting of this Association I now declare adjourned.

Adjourned

Attest:

C. J. H. WOODBURY,
Secretary.

TRANSACTIONS.

FIRST SESSION.

TUESDAY EVENING, SEPTEMBER 27, 1898.

The Association met in the parlors of the Crawford House at 8 P. M., President KNIGHT in the chair.

The PRESIDENT. Among the many reasons that have been assigned for the present depression in the cotton business is that we have too many spindles, that we have too many mills, that too much of our force is employed in the manufacture of cotton goods; and we have been led to look about to ascertain whether there might be some other use made of some of the numerous mills that we now have. Among the other possibilities Mr. S. N. D. NORTH, of Boston, Mass., will read us a paper entitled, "The Linen Manufacture in New England: Its Possibilities and its Limitations."

THE LINEN MANUFACTURE IN NEW ENGLAND: ITS POSSIBILITIES AND ITS LIMITATIONS.

S. N. D. North, Boston, Mass.

In the textiles, no man knoweth what a day, or an hour may bring forth. There is always something new under the sun — some new mechanism for quickening or cheapening processes; some new fabric to crowd out the old ones; some new combination or manipulation of fibers, like the mercerization of cotton, or some new wrinkle of fashion, to upset the markets; some evolution in trade conditions, some readjustment in costs, which advances the outposts of the industry, startles men who have grown gray in the service, and sets the world to wondering, what next? One year counts for more than a thousand in the days of distaff and handloom. Just now the textile industries are in a state of tension and transition. The very foundations seem to be shaken; the conditions of successful manufacture are changing, no man knows just why or how, but all have their ears to the ground. If six-cent cotton has come to stay, it means an economic revolution to which not simply the cotton manufacture must adjust itself, but also the wool industry, which begins to realize that a raw material carrying a duty of 22 to 33 cents per scoured pound has an ugly tussle ahead of it, with the six-cent fiber — the most marvellous of all nature's gifts — the magic fiber, the very imp of industry, we may call it, since it shows itself capable of transmutation into the semblance of silk or wool, or flax, defying the public to detect the masquerade.

Much has been written recently about the introduction, or the re-introduction, of the manufacture of linen in New England.

Some of this literature has been more or less tinged with exaggeration. It has seemed desirable that there should be a study of the actual facts and possibilities in this proposed field of enterprise, and peculiarly appropriate that such a study should be presented to the New England Cotton Manufacturers Association, since the hope has been alluringly held out that the New England cotton manufacture, by turning a good share of its looms upon linen fabrics, can promptly recoup any loss of business arising from the increasing competition of Southern cotton mills, operated at lower labor costs.

What I do not know about the linen manufacture would fill a royal octavo volume; but, by avoiding all attempts to enlighten you on the technical intricacies of the industry, and by looking at the question from the practical and business point of view, we can perhaps spend a profitable hour together. And, first of all, let it be said that it is not worth while to attempt to deceive ourselves. This is not a study to be approached from the sentimental point of view. Linen has a glorious history among the textiles; but we are concerned with its future, not with its past. It is well enough for Mr. CHARLES RICHARDS DODGE, the industrious fiber investigator of the Agriculture Department, to remind us annually that linen was the fabric of the stone age, and was manufactured by the Swiss cave dwellers five thousand years ago; the cave dwellers are not numbered among to-day's customers. It is interesting to know that the Egyptian mummies are found swathed in pure linen cloth which has defied the tooth of time; it is not the mummies but the living millions that are to be clothed to-day. Purple and fine linen were the raiment of royalty and priesthood in prehistoric ages. The antiquarian fills volumes with dissertations upon the uses to which linen was devoted, and the exquisite textures into which it was wrought by aid of embroidery and gold and silver threads; but the average New England business man is not an enthusiastic antiquarian, and the question he asks is, will it pay? Our own ancestors used a deal more of flax than of cotton, growing their own fiber and spinning their own yarns for the "linsey-

woolsey" fabrics which comprised their staple wear; but they had neither machinery, nor factories, nor corporations, nor selling houses, nor labor laws, nor trades unions.

The first question that asks itself is: What is the present market, and what is the possible future market for linen fabrics in the United States?

Mr. ALEXANDER J. WARDEN of Dundee, the historian of the linen industry, declares that there are more linens consumed in the United States, in proportion to population, than in any other country, and the Encyclopedia Britannica asserts that our country consumes more linen than all other countries combined. These statements are founded upon the fact that more than one-half the yardage of the British export of linen piece goods goes to the United States. Thus, of an average annual export of 150,000,000 yards, the United States takes an average of 85,000,000 yards, the next largest customer, strangely enough, being the Spanish possessions, taking about 19,000,000 yards.*

* The total exports of linens from the United Kingdom have been as follows, in the years named:

	Piece Goods, Plain or White.		Total Exports, Included checked, dyed, and sail cloth.	
	Yards.	Value, £.	Yards.	Value, £.
1871	220,467,476	6,911,223	. . . . .	. . . .
1881	173,853,300	5,163,669	. . . . .	. . . .
1891	144,416,700	3,263,463	159,451,700	5,032,196
1892	156,254,800	3,448,189	171,302,500	5,165,902
1893	139,682,300	3,125,213	158,335,300	4,775,140
1894	135,157,200	2,895,000	156,254,000	4,504,658
1895	178,865,500	3,488,369	203,587,600	5,351,025
1896	150,849,300	3,146,341	174,208,000	3,764,889

The exports to the United States have been as follows:

Exports of Linen Yarns from the United Kingdom to the United States. British Production.

	Pounds.	Value, £.	Average value per lb. Pence.
1891	375,200	14,229	9 2-16
1892	532,900	17,486	7 14-16
1893	476,800	17,280	8 11-16
1894	245,500	9,412	9 3-16
1895	474,000	18,991	9 10-16
1896	658,700	31,492	11 18-16

These figures, while they show the importance of the American market to Dundee and Belfast, are likely, standing alone, to convey an exaggerated impression of the relative importance of our market for linen fabrics. All the linen fabrics consumed in the United States, save crash, and the cheapest towellings, are imported,* or were until within a year or two; hence we

Exports of Linens from the United Kingdom to the United States. (British Production.)

	Yards.	*Value, £.
1891	80,603,900	1,720,133
		680,838
1892	96,475,000	2,012,838
		682,963
1893	85,258,400	1,804,024
		600,958
1894	84,721,700	1,681,327
		509,013
1895	126,620,200	2,198,840
		659,851
1896	100,454,700	1,914,817
		596,426

*The second line shows the value of exports of other linens than piece goods.

*The Census of 1890 reported under the head of "linen goods," only $547,273 as the value of the product of the manufacturing establishments in the United States. The product of the thread and twine mills was not separately reported; but we can closely estimate it from the following table of the quantity and value of the flax fiber imported, in its several forms, no domestic grown fiber being used in these mills:

Imports of Flax Entered for Consumption 1890-1897. Quantities and Values.

	Not Hackled.		Hackled, Known as Dressed Linen.		Tow.		Total.	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value
1890	3,984	$872,507	1,618	$951,807	1,544	$222,287	7,146	$2,046,601
'91	3,647	782,909	1,087	650,582	1,970	291,131	6,704	1,724,622
'92	4,288	905,938	1,158	726,142	2,297	344,434	7,743	1,976,514
'93	3,261	759,421	1,307	815,290	1,925	291,338	6,493	1,866,049
'94	2,388	594,922	882	578,921	989	147,980	4,259	1,321,823
'95	3,118	814,603	1,798	951,291	1,863	301,916	6,779	2,067,810
'96	3,788	909,658	1,323	639,368	1,712	261,082	6,823	1,810,108
'97	4,975	945,966	1,708	641,142	2,481	310,345	9,164	1,897,447
Total 8 yrs.	29,439	6,585,918	10,881	5,954,543	14,781	2,170,513	55,111	14,710,974
Annual Average	3,681	823,240	1,360	744,318	1,848	271,314	6,889	1,838,872

know the wholesale value of the domestic consumption from the returns of the Treasury Bureau of Statistics. Here is a statement of these imports for the past ten years excluding therefrom the items of twine, yarn, thread, netting, collars and cuffs and laces:

LINEN CLOTHS, ETC., ENTERED FOR CONSUMPTION 1888–1897 INCLUSIVE.

	VALUE.	DUTY.
1888	$14,273,134	$4,999,588
1889	14,978,502	5,245,067
1890	16,048,740	5,618,985
1891	13,658,665	5,178,458
1892	12,999,807	5,136,639
1893	15,049,343	5,800,904
1894	10,309,608	4,047,871
1895	14,427,620	5,105,035
1896	14,114,931	4,940,226
1897	16,879,558	5,907,845

The average annual foreign value of the imports for ten years is about $15,000,000 and the duty paid value about $20,000,000. It was stated by Mr. DAVIS, in a paper read at the last meeting of this Association, to be over $30,000,000. By some inadvertance, Mr. DAVIS got the amount one-half larger than the duty paid value really is. This table reveals no tendency towards an increase in importation, notwithstanding the increase in population and wealth, and the absence of a domestic production. It follows that in the per capita consumption of linens, there has been a steady decrease. Away back in 1859, the imports of linens were valued at $10,173,127.

The value of cotton goods manufactured in the United States was $267,981,724 in 1890, an increase of nearly 40 per cent. over the value reported in 1880. All knit fabrics were excluded from this total. Assuming that the increase since 1890 has been but 25 per cent., the value of cottons now manufactured must be annually about $335,000,000. Of the product of 1890, 16.75 per cent. were yarns and threads, and some portion of this was

undoubtedly duplicated in the aggregate value of cotton manufactures reported. Deducting 16.75 per cent. from the above estimated total, we have $280,000,000, as the present value of woven cotton goods annually made in the United States. The duty paid value of the imports of linen fabrics is one-fourteenth of the value of the cottons thus made. In 1890, there were 187 cotton mills in Massachusetts, making goods valued at $100,202,000, an average of $535,000 to each mill. In other words, 38 mills of the average capacity of Massachusetts cotton mills in 1890, could manufacture all the linen goods consumed in the United States. These linens equal only one-fifth of the Massachusetts cotton mill product of 1890, and could be made in one-fifth of her mills.

This is looking at only half of the question. The linen consumed in the United States, while only one-fourteenth of the cotton product consumed, is divided up among a large variety of products, such as crash, duck, damasks, napkins, shirtings, sheetings, towelling, etc.; when these goods are apportioned among the different varieties, they represent a comparatively small quantity of each. The finest qualities it is not to be expected we can make in this country — at least for years to come and only after much experimentation. It is well to remember also, what the wool manufacturers know to their sorrow, that when it comes to fine goods, where price does not count, there is a deep rooted prejudice among Americans in favor of foreign made goods, merely because they are foreign made. If we exclude from our calculation the goods thus out of the question, we shall reduce the amount under consideration by about one-half, or to $10,000,000. It is about $2,000,000 less than the value of the corsets annually made in the United States.

It is worth while to manufacture such linen fabrics as we can, to supply this home consumption of $10,000,000; it represents a tangible, concrete amount of business now enjoyed by foreigners; and I am one of those who believe that we should make, in this country, everything that we can make profitably and equally well with those who send it to us from abroad. I am

simply showing by the figures that, assuming we can, in the course of time, supply all the domestic consumption of linen, we should still have accomplished practically nothing to relieve the situation in the cotton manufacture. Assuming that we could make in Massachusetts all the linen now imported, we should have added to the value of the manufactured products of the state, as returned by the Census of 1895, less than one and one-fifth per cent. That is worth adding; but it is not worth exaggerating. If we are to enter this industry, we must do it for the sake of the industry, and not with the expectation of thereby relieving a congested market for cottons.

Moreover, the consumption of linen does not promise to greatly increase, as a result of home develoment. Unlike woolen, worsted, cotton, silk, and even jute fabrics, linens show no tendency to increased use in any given ratio to the increase in population. The modern history of the industry has been curiously fitful. In the transition from a hand to a machine industry, linen lagged far behind the rest; as the consumption of cotton goods marvellously increased and multiplied with the application of power to their manufacture, they literally drove linen out of the field, and the industry was nearly moribund in Europe in the earlier part of this century. By slow and costly steps, spinning and weaving machinery were gradually applied to flax; the industry was fairly back in the race for competition again, when our Civil War broke out, and the world's cotton famine followed. Then came, in the words of Mr. WARDEN, "a mighty impulse to the linen industry." New mills were built, gigantic fortunes were made; Dundee and Belfast grew like Jonah's gourd. But when war ended and cotton was grown again, the collapse was as sudden as the revival had been, and the production of linen fabrics has never since reached the volume it attained during those five years. In fact, it has been declining from year to year, if we can judge by the statistics of export or of machinery employed. The table of British exports already given, shows a yardage of 220,467,000 exported in 1871, which has never since been equalled. In 1875 the total number

of flax spindles throughout the world was 3,250,979; and in 1895 this number had been reduced to 2,673,753.* This seems like a pretty small total, in comparison with a grand total of 93,600,000 cotton spindles in the world.† It is precisely one to 35. This is the true test of the relative importance of the two industries to-day.

I am unable to find, after diligent search, any authority for Mr. DAVIS'S statement that "with the steady rise in the standard of living of the masses in civilized countries, the per cent. of linen goods used is constantly increasing." The statistics available show that just the reverse is the fact. MULHALL says‡ that flax-growing has been on the decline in most countries, except Russia, during the last ten years. He adds that "of late years the linen trade has been declining, especially as regards home (English) consumption, which averaged eight yards per inhabitant in 1840, and is now less than five yards."§

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* Of this number Ireland had 887,587 spindles in 1875, and 849,410 in 1895, the number in the former year being 27 per cent. of the total number, while in the latter it was 31 per cent. So that, while the industry in Ireland has somewhat declined, it has more than held its own, in comparison with other countries. In England the decrease has been from 291,735 spindles in 1875 to 75,000 in 1895, a remarkable decrease, only approached by that in Scotland, where the decline has been from 275,-119 spindles in 1875 to 187,755 in 1895. There has been a feeling that this decline was chiefly due to a great increase in the spinning capacity of Germany, but the statistics do not carry out this conclusion, for there has been a slight decline in that country also, from 326,538 in 1875 to 299,089 in 1895.

† See "Shepperson's Cotton Facts," page 6.

‡ "Dictionary of Statistics," page 280, 1891.

§ See also "Wealth and Industry of Nations," by Michael Mulhall, page 74. Mulhall gives the following table of the comparative consumption of fibers in Europe and America, in the years 1840-1894 in tons:

	Cotton.	Wool.	Flax, Hemp and Jute.	Total.
1840	380,000	340,000	590,000	1,310,000
1894	2,226,000	1,068,000	1,544,000	4,838,000

According to this table, even when its statistics are combined with those of hemp and jute, flax has not held its own, either with cotton or wool, in the percentage of increased consumption. The increased use of jute has been the most striking phenomenon in the recent developement of textiles. It first came to the attention of

There are obvious reasons for this decline: linen is not, and, because of its price, cannot become a substitute for cotton. Cotton is, on the other hand, a substitute for linen in many uses, and in the evolution of the textile industry, is becoming more and more a substitute for linen.

To illustrate, here are samples of crash, made wholly from cotton yarns, in one of our Massachusetts mills, in which the linen effect is so skillfully imitated that it needs an expert to detect it, until after several washings at least. Price is, of course, the chief reason why this process of substitution increases. And yet the margin of difference between the first cost of the two raw materials is not so great as is commonly supposed. I have here samples of a Russian flax which was delivered in Boston at a cost of six cents per pound, of which one cent is duty, and which I am assured can be carded and spun into a very satisfactory tow weaving yarn as fine as 16 lea. From six to eight cents a pound will represent the present prices paid for the Russian flax mainly used for ordinary yarns in weaving the bulk of linen goods. But the finest qualities of Belgium flax cost 30 cents per pound; and in the comparison of values with cotton, the much greater waste of the flax fiber must be taken into account, as well as the much greater labor cost of the preparatory and spinning processes. It is not yet possible in spinning to attain one-half the speed that is common with the cotton spindle; the doffing is comparatively slow and expensive, and one spinner can attend but two sides, the nature of the fiber causing much more frequent breakage, especially in starting after doffing. Mr. JOHN H. ROSS, of the Boston Thread and Twine Company, expresses the conviction that, given pro-

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European manufacturers in 1850, and its consumption now exceeds 600,000 tons per annum, and the value of the output of the British mills was reckoned at £12,300,000 in 1895, the value of the output of the British linen mills in the same year being calculated at £13,000,000. In quoting Mulhall, I admit that his method of compiling statistics has been much criticized; but his data as above recorded accords with the export statistics of the several European countries, as far as I have been able to examine them.

cesses of manufacture equally perfect and economical with those of cotton, flax can hold its own, taking price and quality both into consideration, in every use where cotton is now used as a substitute. The statement indicates that the future of linen may not be as circumscribed as present appearances indicate. But meanwhile cotton machinery advances faster than that devoted to flax; and facts will be stated at this meeting which show that it is on the eve of vast improvement at the point where flax is weakest — in the preparation for factory handling. Perhaps when Yankee brains get fairly at work upon this flax machinery, it will be brought abreast with the times. I am told that the demand of an American mill for linen yarn put up on cops, has led within a year to the introduction of that improvement in the Belfast mills.

I have tried to find some definite ratio of comparative prices, on the basis of the yarn; but there are difficulties in the way of an exact demonstration which are insuperable, as practical manufacturers will readily understand. For instance, here is a tow weaving yarn, No. 16 lea, spun in Massachusetts, worth say 19 cents a pound, which in fineness may be contrasted with a number 12 cotton yarn worth 12 cents. But as we go to finer numbers, the difference increases. These differences, traceable chiefly to defective mechanical appliances, explain the fact that the areas devoted to flax production have not increased, outside of Russia, whose dew retted flax is unsuited for very fine fabrics. Moreover the process of retting still defies the cheapening methods of modern chemistry and machinery. Flax retting remains the slow, laborious, uncertain, filthy process that it was in the days of the Pharaohs; the labor cost not only forbids its successful undertaking in this country, but forbids any actual competition with the cotton fiber, that needs only to be separated from its seed to be ready for spinning.

Linen feels the pressure of cotton from above, and of jute from below. In many of its coarser forms and uses, jute has superseded the flax fiber, because of its relative cheapness, and because it is more easily handled mechanically. In some quarters

it is called the shoddy fiber, and it is fitly named; wherever it touches the textiles it deteriorates the fabric.

Thus for economic and mechanical reasons combined, the use of linen is coming to be more and more confined to the wealthy. It is a luxury, and a luxury upon whose original province, in one or another form, cotton or silk are steadily encroaching. Its use for underwear, once very wide, has practically ceased. Of all the textiles, linen is the best conductor of heat, which means that it is the least desirable for fabrics next the skin. For bed linen, where it was once thought indispensable, the majority of us, in a free choice, would prefer, the year round, to sleep between cotton sheets. Into the sanitary aspects of the question I shall not enter. The experts have been fighting over cotton, wool and linen, from that point of view, for a century; while they are disputing, the great common sense of the people, indifferent to medical opinion, goes on the way marked out by experience.

Nevertheless it remains the fact that linen possesses certain splendid and unique characteristics, which no other fiber can imitate or approach, and which will bid defiance to cheapness, ingenuity and imitation for all time to come. There is a toughness, a sheen, a smoothness and a durability to the fiber of flax, which combine to make it unrivalled for special uses. No manipulation of cotton is possible whereby it can supersede the tough but delicate thread that forms the hand-made lace whose artistic beauty makes it worth its weight in gold. It can never drive the figured linen damask from the luxurious dining room. Its endurance, combined with its comparatively quick absorption of moisture, render linen supreme in the towelling of the kitchen and the bedroom. For dress fabrics, also, linen has certain characteristics which will always command a limited market. In hot climates it is unsurpassed for outer wear. Its use relatively will probably continue to decrease; its use absolutely may even continue to show a slight decrease; its continued staple employment for specific purposes is certain. But I emphasize the fact that in its finer forms the linen industry has become

a highly specialized manufacture; that it involves small production and high labor costs; that generations of experience have confined its production to comparatively few centers, and few mills abroad; that it is not adapted to the wholesale productive methods of the American system, and that, if our manufacturers are wise, and careful of the money of their stockholders, they will be cautious about attempting to rival those exquisite productions of foreign looms, which are the real glory of the linen manufacture. The famous Maison Blanc near Paris, whose damasks are known the world over, is an establishment consisting of thirty or forty hand looms, where fabrics are woven to order in special designs — your monogram, or crest, or other like device. That sort of linen manufacture, together with Gobelin tapestries and the like, we may well leave to the foreigner for the present.

The next question that asks itself is, how shall the new industry get a foothold in New England?

There are two phases to this question, entirely distinct from each other, and yet so closely related in men's minds that it has seemed impossible to separate them in this country. One has to do with the growing and decortication of the raw material; and the other with its manufacture.

Mr. DAVIS, in his interesting paper, seems to regard the separation of the two branches of the industry as impossible and unnecessary. He would have them go hand in hand, and use the abandoned farms of New England to supply new linen mills, to be constructed on our abandoned mill sites and water powers. On the other hand, whenever there is a revision of the tariff at Washington, the western men are big with promises of the possibilities of flax fiber raising in their country, and bemoan the millions of pounds of fiber yearly burned for want of a home market. Always they forget that the raising of flax for seed, and the raising of flax for fiber are two very different enterprises; and always, when telling of the achievements of the manufacture in their part of the country, they overlook the fact that tow mills are not linen mills.

Into the contention that we can raise all the flax fiber, of the best quality, needed to supply a fully developed linen manufacture in the United States, I do not propose to enter. That controversy is one it is as wise to avoid as the wool question —when one can escape it; and it has no necessary connection with the problem we are discussing. It possesses one point of difference from the wool question, and a vital point. We have in the United States a fully developed wool manufacture, which must be supplied with raw material. Hence it is theoretically held that, given sufficient protection, we can supply, from home sources, the demand for wool which exists and increases. We have no manufacture of linen, and it is a self-evident proposition that we cannot expect a supply of home-grown material, such as is needed for ordinary fabrics, prior to the existence of any home demand. The manufacturing end must exist, must be permanently developed, with its promise of a permanent market, before there is any inducement for the farmer to take up this business as it is pursued in Belgium, Russia, France and Ireland.

Mr. Dodge's recently published Tenth Report of the Bureau of Fiber Investigation of the Agricultural Department, summarizes the results of the flax growing experiments conducted since 1890, in a way that is not only profoundly discouraging, but when read between the lines, seems almost hopeless from the point of view of commercial cultivation. If we can believe that report, the flax farmers of the west have made no progress whatever in the direction of producing a fiber which, by its quality and the methods employed in retting, is fit for anything but upholstery tow.*

* Mr. DODGE thus sums up the difficulties which must be overcome by our flax growing farmers: "The cultivation of a million acres of flax for the seed alone by shiftless practices, which must needs be unlearned before cultivation for fibre can be attempted; too great reliance upon virgin fertility of the soil in newer sections; lack of skill and experience in the handling of a new crop; too much experience, as with some Old World flax growers who have settled among us, this being made apparent in nonadaptability to new conditions and requirements; the lack of several machines needed for economy in harvesting the crop, the most important being an improved thrasher and practical flax puller; the timidity of capital, partly through money-strin-

It is to be borne in mind that there are four processes after harvesting, which belong to the agricultural end of this industry, the drying, the retting, the breaking and the scutching, † each involving hand labor, each affecting vitally the quality of the fiber for spinning purposes, and each having its effect upon the cost. Hence it is that our domestic flax and tow spinners—without exception, I believe, use the imported fiber; quality and uniformity making it cheaper after paying the duty. Some of them import it heckled, and others prefer to do their own heckling. We have built up, in this way, a domestic twine industry, equal to all our wants. Since 1835, when the Smith & Dove works were founded in Andover, we have successfully spun linen carpet yarns; and we are today equipped to spin the coarser numbers of linen yarns, either from tow or line.

In a word, the manufacturer need wait no longer on the farmer. That he is wearied of waiting is shown by the fact that already some ten or a dozen mills, half or more of which are located in New England, have already entered in earnest upon this industry, several of them with conspicuous success, their products meeting with pronounced favor in the markets; while others are still in the experimental period.

All of these undertakings are traceable to the readjustment of the linen schedule in the tariff act of 1897. The last Congress, recognizing the situation as we have just stated it, constructed and enacted the only form of tariff schedule under which it is

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gency, partly through lack of confidence, but largely through lack of knowledge of what is required to start the industry, which must be the result of co-operation between grower and spinner; the inability to properly ret the straw when grown, due to carelessness, to lack of knowledge, and to the want of capital with which to secure the proper appliances for this important work, which is the most serious of all the drawbacks."

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†It should be said, however, that in Belgium and elsewhere the merchant frequently takes over these processes, sometimes buying the crop as it stands in the field, and sometimes taking it after retting. This is possible, where the flax industry is closely concentrated; in a country so large as our own, it is almost impossible, although it is true that scutching mills have been erected at sundry points in Michigan and the northwest.

possible to make headway in establishing this industry. This schedule admits, at the revenue duty of 15 per cent., linen yarns which are finer than 80 lea or number. All the coarse grades of yarns, long made in abundance in this country, are now dutiable at 40 per cent. for grey, 45 per cent. for bleached and for twists at specific rates which are higher.

This adjustment was adopted by Congress chiefly upon the suggestion of Mr. PERCY H. BRUNDAGE of New York, acting in concert and co-operation with some of the large New England cotton mills, the Boott, the Boston, the Merrimac, and others. It was done, as I understand it, with the approval of the several establishments engaged in spinning yarns and twine in this country. These manufacturers, who may be presumed to know what they are about, do not themselves care to undertake, at present, the spinning of the finer numbers. They can see no profit in it, at least until a considerable demand for such yarns has been created; and they know the difficulties which attend the successful production of this class of linen yarns. In a word, Congress has provided that the experiment of building up the fine linen industry shall begin from the weaving end, the bulk of the yarns to be imported.

The development of a linen industry is thus no longer dependent upon a domestic supply of the raw material, or the development of domestic spinning plants for high numbers. It is the only practical way in which to establish the manufacture of the finer linen fabrics in this country. It follows closely the method adopted by Germany, with such conspicuous success, in building up her worsted cloth manufacture. The present is the first time that tariff conditions have rendered the establishment of the fine linen industry possible. Whether the industries precedent will follow, in time, depends upon the success of the direct encouragement now given to weaving. Given the weaving plants to create a market, and they will be followed in time by spinning plants to supply fine yarns. Free to import fine yarns at a low duty, we enter upon this industry under decidedly favorable conditions; for the duties which have been placed upon woven

fabrics of linen make it possible for our manufacturers to gradually take the market for the staple fabrics. It may be answered that the promise of such a result was made when the McKinley tariff act was passed, and that the futility of the effort compelled the repeal of the linen duties of that tariff before the date at which it was provided they should take effect. But this is not a true statement of the facts in that episode. What was really asked in the McKinley tariff was a suitable adjustment between the yarn and the goods duties—three cents a pound and fifty per cent. ad valorem on the latter, and forty per cent. on the former. When the bill was finally enacted, the three cents a pound had been dropped; the necessary differential had disappeared and the whole scheme was a failure before it began.

It remains to speak of the conditions essential to success, and the practical and technical difficulties to be met and overcome. From what has been said, it seems to be plain that the creation of a separate and independent linen industry, by the building of mills for that purpose, is not for the present desirable or even possible. We must feel our way, or sink our capital. Every earlier attempt at the finer linen manufacture in this country has been a failure. The earliest of these, that was really important and promising, was that of HENRY H. STEVENS, of Webster, Mass., in 1847, who won the Talmadge gold medal in 1849, for an exhibit at the American Institute of the first and best piece of American linen spun by machinery and woven on the power loom in this country. Mr. STEVENS took up the manufacture with great enthusiasm, and he carried it on to immediate disaster. His successors have made a success out of the manufacture of crash and the cheaper grades of towelling.

Even more notable was the American Linen Company, at Fall River, established in 1852, with a complete plant of imported machinery, including 4,000 spindles and 200 looms. In 1855 it exhibited at the American Institute a large variety of power loom fabrics of excellent quality, including table cloths, napkins,

diaper, sheeting, towelling and crash, and a year or two thereafter it was converted bodily into a cotton mill.

Allusion might also be made to the Boston Flax Mills, at Braintree; to the Stark Mills at Manchester, N. H., which once installed several systems of flax spinning machinery, which it subsequently converted into old iron; and to the peculiarly disastrous venture of the late Senator SPRAGUE in Rhode Island. The failure of the linen manufacture heretofore is not due to lack of effort; much money has been spent, for which there is nothing to show. It suggests that we have gone at the business in the wrong way. I draw the lesson that the cotton mill is the natural birthplace for an American linen industry—for three reasons. First, the cotton loom, both plain and fancy, is adjustable to linen weaving. Second, the relationship between linen and cotton fabrics is intimate, often to the point of interchangability, suggesting advantages and economies both in the making and marketing of products. Third, the two fibers work naturally in combination, for the production of union fabrics. Indeed, it may be assumed that the first successes, and the most promising results, will come in the making of these union fabrics, such as towellings, sheetings, dress goods, etc. The combination fabric is growing in popular favor: it is clearly the pathway of future development. There are certain distinct advantages in these union fabrics, such as the retention of the special characteristics of linen, with an approximation to the cheapness of cotton, which promise a steady increase in the popular demand for them. So true is this that it might almost be said that the up-to-date fancy cotton goods mill must know how to vary its product in this manner, if it is to meet every passing phase of fashion and taste. Linen occupies a relationship to the cotton manufacture, somewhat similar to that of mohair to worsted dress goods: much of the time there is but little demand for mohair effects; then of a sudden there is little demand for anything else.

Nevertheless, I am inclined to think that the distinct successes in the weaving of linens will be most conspicuous in the smaller cotton mills. The varieties of goods are so numerous and

the demand so relatively small, that in a large mill, where looms are run to best advantage without frequent shifting, the amount of detail involved in an attempt to produce many varieties of standard linens would certainly interfere with the profits. Whether the mill be large or small, it should confine itself to the weaving, relying for its yarns upon those who make a specialty of spinning. This is the method of manufacture chiefly followed abroad; and long experience has demonstrated that it is attended by the best results.

The same is true of the finishing processes. Nearly all the piece goods made at Belfast and Dundee are bleached and finished in separate establishments, which confine themselves to these processes. Successful bleaching is no longer dependent upon open air exposure in the fields; although there are those who claim that in the finest goods the modern quick methods can never equal the old-fashioned field bleaching; and the retention of many of the bleaching fields abroad would seem to confirm this view. The finishing machinery of the linen industry is so unlike that of cotton, that the processes have little resemblance. The Lowell Bleachery has introduced a complete set of this ponderous and slow-moving machinery, including a beetling, a mangling and a calendaring machine, and has successfully imparted to all the varieties of goods brought to it, a finish which equals anything found in foreign goods. The goods offered have kept this machinery actively employed since its installation last spring. That additional finishing machinery will be at command, if the need for it develops, goes without saying.

In a word, to summarize the situation, all the processes connected with the linen manufacture are now in successful operation here, and the gradual development of the germ seems assured. But the painful parturition of this industry has served to bring out, in bold relief, the inherent difficulties surrounding its firm establishment among us. The linen manufacture is the most difficult and perplexing of all the textile industries. If it were not so, it would not have been the last to which automatic machinery was successfully applied. Given the necessary capital,

you can start a cotton mill at its full capacity the day the engine is fired,—as some of you know to your sorrow. With linen it is very different; and the chief difficulty in the way today is not a difficulty of climate,—for that, it is agreed, can be discounted,—but the lack of knowledge of the fiber, and of skill and experience in handling it. Though you know cotton as well as a mother knows her baby, and just what to do in every emergency, the knowledge will help but little in handling this fiber, so different in "nature", so brittle, so uneven, so non-elastic, so cranky, so preversely reluctant to travel in harness with any other fiber. I heard it remarked by a foreign manufacturer who has been watching these experiments in the United States, that the chief obstacle in the way of immediate success was the confident belief of everyone that he knew just how to do it, without ever having tried. It has already been learned in more than one mill, that knowledge of linen weaving can only come at the end of costly and continuous experiment. Some of those who have given a year or more to this experimentation are on the point, as I know, of giving the matter up, convinced that they cannot succeed in reducing costs to a point where it will be possible to compete with the imported fabrics. Perhaps if these experimenters, instead of secretly attempting to learn the business by themselves, had obtained skilled assistance from abroad, their experience would have been less costly and more valuable. Only experts can solve the problems of the weaving room and finishing room. Expert knowledge of the yarns themselves is at the root of the business. Just what can be successfully accomplished with a particular yarn,—just what are the relationships to each other, to cotton yarns, and to particular fabrics it is desired to copy, of the great variety of linen yarns; whether to use unbleached, quarter-bleached, half-bleached, three-quarter bleached, full-bleached yarns, or tow or line yarns, or dry or wet spun yarns, or hard or soft twisted yarns, to secure desired effects; what are the percentages of waste in reeling, beaming, etc., are problems upon which experience in cotton manufacture throws little light, and upon which it is imperative

to get intelligent advice. None of them, however, are difficulties which cannot be overcome, or which need daunt the enterprising manufacturer who has determined to grapple with them.

I conclude where I began: there is always something new under the sun, and no problem in manufacturing is beyond the ingenuity of man to solve. He would be a fool indeed, who stood before you and predicted that this, or that, or the other thing in reference to this industry, or any other, is impossible of accomplishment. When SAMUEL LISTER worked out the problem of reeling and combing silk waste, he brought about a revolution in that industry, which enormously increased the consumption of silk. But for the successful application of power to wool combing by Sir ISAAC HOLDEN and others, half a century ago, the vast reaches of Australia would not now be nourishing their millions of sheep. Some mechanical genius, perhaps some Yankee already born, may yet accomplish a like service for the flax fiber, a service that will restore it to its proud preeminence in that splendid Egyptian civilization over which we marvel and cease our boasting.

The PRESIDENT. I am sure we have all been greatly interested and are grateful for the very valuable paper presented by Mr. NORTH. I will call on Mr. PERCY H. BRUNDAGE of New York who is present to open the discussion of this paper.

Mr. PERCY H. BRUNDAGE. Mr. President, ladies and gentlemen, I have been asked by the President to make a few remarks on the subject of this paper of Mr. NORTH, largely because I have made some study of the linen business from a purely theoretical and not at all technical standpoint. There are not many statements of Mr. NORTH'S, if any, that I

can take exception to. In fact, if there are any, they are purely matters of opinion. In the first place, Mr. NORTH says that the domestic value of the importations is in the neighborhood of $20,000,000, which, of course, is statistically correct. He deduces from that fact the further fact that the probable possible American industry will not amount to over $10,000,000. In that figure I think he is a little bit wrong. I think it would be more exactly said that it would be much nearer $15,000,000 than $10,000,000. Now, as nearly as such a thing can possibly be estimated, it will probably require in the neighborhood of 10,000 looms to produce $10,000,000 worth of linens. I have tried to arrive at some estimate as to the number of cotton looms in the New England states, but I have not been able to find anybody who could give it to me; but certainly, 10,000 looms in a new industry are worth working for, and it was with that idea that all the representatives in Congress and the two senators from Massachusetts acceded to the request of these large Massachusetts cotton mills in so framing the tariff that in accordance with their ideas linens could be made here. Now, some of our mills have been working on them to my certain knowledge for prehaps nine months. The efforts so far have been almost entirely in the line of union goods. I know that they have been successful as far as they have gone. I know that there are one or two mills which have tried to go too fast, which have failed. Mr. NORTH very truly says that because a man knows how to weave cotton it does not necessarily follow that he knows how to weave linens; he has a great deal to learn. But any mill in New England of any calibre, large or small, if it picks out the right goods, can by careful experiment learn how to make linens. That there is a profit in the goods that have already been produced there can be no question; that there is a profit in the further development of the industry seems to be pretty well assured by some experiments that I know pretty well about.

Now in regard to the differences in the differentiation of product between cottons and linens as affecting the size of the mill in which the latter are to be made, there are comparatively few

lines in linen goods that a large mill can successfully take hold of without overloading the market, but there are such lines, certainly five or six. The balance of the linen industry must be confined to small mills, for the reason that the same classes of goods are made in innumerable different widths and different counts and only sold in very small quantities, but in the aggregate amounting to quite an industry. That part of the business, it does not seem to me, interests the cotton manufacturers here as much as the larger lines, by which I mean towels and cheap damasks, chiefly union damasks — cotton warp and linen filling. That is an industry that can certainly actively occupy 300 broad looms. That, perhaps, from a New England standpoint, does not sound large, but it is quite different from 300 narrow looms, as you all know. Union towels alone would give occupation for 2500 looms. That is a figure that I have arrived at by careful consultation with New York linen importers, and they all agree that this country takes practically all the union fabrics made in Belfast and other centres. It was the McKinley bill of 1890 that induced the Belfast manufacturer to try to cheapen his product, and he did it by putting a cotton warp with his linen filling. It had been done before, but never to any extent.

Now, one of the mills in Massachusetts, following in that same line, has gone further than Belfast and is producing today, as I know, and successfully selling in New York city, a union hemstitched sheet, pillow case and bolster cover. I know they are successful; I have seen the goods. They are made by weaving cotton warp with linen filling, the filling yarn being about No. 40, which is considered pretty fine for this end of the industry; and this sheet, Mr. NORTH'S paper to the contrary notwithstanding, is the most comfortable bed-clothes that you can put on. It has all the beauties of cotton without any of the disadvantages of linen. Anybody can find that by trying it.

Now, the troubles to which Mr. NORTH has referred, to which cotton mills are subjected, are inherent in the fibre of the flax yarn. Flax is absolutely non-elastic. Although it probably in the same comparative number would have a strength anywhere

from three to six times as great, according to its quality, in weaving or in winding, if there comes the slightest catch it will snap, particularly if the atmosphere is very dry, where the cotton yarn, with its elasticity, would give.

Now, when the cotton mills here started in 1896 weaving union dress fabrics they found that one of the greatest difficulties they had to overcome was learning to wind the yarn to get it ready for the shuttle. One of our mills overcame that by importing the yarn already wound in a shuttle-cop. That sounds, perhaps, very simple, but it may surprise you, gentlemen, to know that cop winding was never used in Belfast. They always wound their yarn there on what they call a "pirn," or a bobbin, or a quill. The economy in winding from a cop is very apparent to any mill man. I simply cite that to show that in nine months an American manufacturer has economized the weaving of linen in one particular.

Mr. NORTH has alluded to the fact that linen consumption does not increase — practically has not increased in forty years. That is statistically absolutely correct. But I think he has forgotten to mention one of the probable causes, namely, the fact that during those forty years the value of a given cotton fabric has been uniformly declining, whereas the value of the linen fabric is pretty near the same as it was forty years ago. The result of that is that the cheapening of the cotton fabric has enabled that fabric to take all the increase that would normally have gone on to the linen fabric. Now, I do not know that I am correct in this assumption, but it seems to me probable that cotton fabrics are pretty nearly as cheap as they are ever going to be. I do not think that linens are. I think if the American mills get to making linen goods they will learn how to economize, as I have shown you one instance where they have already done it. If cotton fabrics stand still, and if linen fabrics stand still or grow cheaper, the normal increase in the use of linen goods will be considerable, and I have no doubt that in the next twenty years the possible American production will amount to $25,000,000, which will make it still more worth working for.

In regard to what Mr. NORTH says about how to get into this business, I entirely agree with him, that it is foolish to assume that flax can be economically grown in this country to put into fabrics. I do not think it can be done at the proper prices. The occupation is exceedingly laborious; our farmers are not accustomed to that kind of work; they do not like it, they will not do it, and they can actually make more profit per acre by selling the flaxseed than by selling the flax fibre. Now it seems to me very evident that flax raised for the seed cannot produce the fibre for spinning. As an instance of that, or as a simile, I suggest that you think a moment of an ear of corn. If you want to cook that to eat it, you want to pull it before it is fully ripe; it has all its sweetness and juice in it. If you want to pull that same ear of corn to be sowed to germinate you wait until it is fully ripe. The same thing exactly applies to flax. Flax grown for fibre, in the first place, needs to be much more carefully grown, but apart from that it must contain in its stalk all the essential juices of the fibre. The minute it ripens some of that juice passes into the seed. If you are going to make linseed oil you naturally want to buy the seed when it contains the largest possible amount of juice. That juice must have come from the stalk, at the expense of the fibre. Therefore, it does not make any difference what economical processes are arrived at or discovered for utilizing the flax straw of the western farm; they can only produce the fibre that is in that straw, and that fibre is not fit for spinning into yarn or weaving into fabric. That is, of course, entirely apart from the question of raising flax for fibre, but it is one of the ideas that have been prevalent in the western farmer's mind when he comes to Washington, as Mr. NORTH tells you, that that straw can be utilized. Today they burn it for fuel; you can buy it for the cost of carting; and they have an idea that if they get six or eight cents a pound duty on flax this straw will be used. They do not stop to think that if they get this duty of six or seven cents a pound the linen cloth will be so expensive that you cannot afford to buy it. It is my idea — and I think I am correct — that if the tariff is left alone,

or if it is to be altered, which I hope will not happen for many years, if flax is put on the free list, the domestic yarn spinner protected by a duty of 30 per cent. and the American weaving industry protected by a duty of 50 per cent. on all-linen and union fabrics, the linen product of the New England states will within ten years be $10,000,000. That is my opinion; I do not know that it will be sustained, but I think you will find it so if you study it. [Applause.]

The PRESIDENT. I will call on Mr. JOHN BELL of Andover, if he will favor us.

Mr. JOHN BELL. Mr. President, ladies and gentlemen, after such a paper as we have listened to and the remarks just made by Mr. BRUNDAGE, who knows more in five minutes about weaving linens than I know in a year, it seems to me that there is very little left for me to speak about. I know very little about cotton manufacture, being altogether engaged in the manufacture of linen yarns, in which I have spent all my life since boyhood. The great problem that confronts and has confronted the linen spinning industry in this country ever since its inception is a market for some staple part of their product, such as weaving yarn which they could produce and sell as cotton yarns are sold, or as linen yarn is sold in Great Britain,— something of which they could manufacture and lay aside in a dull time say twenty, thirty, fifty or a hundred tons and have a market for it. We have hoped but with slight prospect of seeing accomplished, that linen weaving would start here. As Mr. NORTH has mentioned in his paper, there have been various attempts in New England at times to introduce linen weaving, but they have been started on a scale that indicated failure even from the start. It seems to me that the very position with which you are confronted as cotton manufacturers is most propitious to us. The only chance of introducing linen weaving in America is found in this condition. When times are depressed and a certain amount of machinery is idle, that is the time when a cotton manufacturer

or any other manufacturer will look about for other products to use his looms upon and he has the time for experiment. His fixed charges are carried on to a great extent by his regular product of cotton, and, therefore, what expense he incurs in linen weaving will not necessarily have to carry that burden, which has always had to be carried by the industries that have hitherto been started entirely for the weaving of linen.

As spinners we have been told that we could not spin linen yarns suitable for weaving into fabrics in America. As an American I would say we can do anything, and as a linen spinner I would say we can spin any kind of yarn here that can be spun anywhere. The only question is, Is it policy to do it? or as Mr. NORTH has put it, Will it pay? We have decided that it will not pay,—at least, so far as the mill that I represent is concerned — that it will not pay to produce the finer counts of linen yarns. For instance, in the coarser linen yarns one girl in spinning will bring off a production from the spinning frames of 250 pounds. If that is increased above 35 lea, that same girl will produce only about 35 pounds, and as you go up to 60 lea yarn you get only a production, prehaps, of 25 pounds, and getting it finer the production is so small in pounds that it would take thousands of spindles to produce what would be used in one mill. Therefore, I would say that the cotton weaver should hardly look for an American product much above No. 30. Now I do not say that finer numbers are not produced here. We spin 40s and 50s; some of our competitors spin 60s and 70s. But that I hardly think for a number of years will be done to any great extent, because the labor entering into the product is such a great portion of the cost that it will not pay; and that being the end for which we are all working, I should say that we would leave the yarns at least above 40 for importation.

I think, perhaps, that one point that Mr. NORTH touched upon is very important in this matter. While it may not be advisable to import help to do what we can do here in America, still, I find in the cotton industry, also in the woolen mills in my neighborhood, that if a new fabric is to be brought out, if a

new loom is introduced to any great extent, there is at least one man brought over, it may be from France, it may be from England, but in very many of those mills that one man is brought with the machinery introduced there to start the process of manufacture. I think, perhaps, that may be one thing that we need to introduce the linen weaving. I am told so, at least, by those who have been interested in it abroad. Of that you know more than I. [Applause.]

The PRESIDENT. The Secretary will read a communication on the subject from Col. SAMUEL WEBBER, who is unable to be present at this meeting.

Col. SAMUEL WEBBER. Since the last meeting of this Association, when I made some remarks on the usual methods of handling and preparing flax for mannfacture, two new projects have come to my notice, of utilizing the fibre of the ripe flax. One is that of Mr. OWEN SHEEHAN of New Bedford, an old flax spinner, who, accompanied by a Mr. HATHAWAY of New Bedford, has gone to Holden, Missouri, to carry out his experiments, which, as I now understand, cover both the harvesting of the flax and clearing of the seed, without destroying the fibre; and the chemical treatment of the straw so as to destroy the woody portion and leave the fibre in proper condition for spinning.

The other is the process mentioned to me in a letter from Mr. HUGH H. LAMONT of San Francisco, covering the harvesting and "rippling," or clearing the seed from the stalk, without injury to the fibre, but says nothing about the process of retting.

If we should apply Mr. WELLS' old process, previously mentioned, to this, we have two rival systems for utilizing the ripe flax, and notes of both of these have been published in the *Boston Journal of Commerce.*

In my remarks at the last meeting I spoke entirely from memory of the information I gathered nearly fifty years ago, but I have since then been looking up some of the literature on the

subject, of which I find plenty in all the cyclopedias, and find in Dr. URE'S *Dictionary of Arts, Manufactures and Mines* that the proper time to pull flax is when the stalk at the bottom and the seed pods at the top begin to turn yellow. The seed is then fit to crush for oil, though not ripe enough to germinate, for which purpose enough for next year's seed must be left to ripen fully.

It would appear probable that the natural juices left in the stalk at this period of growth would aid in the fermentation and retting of the woody part of the stalk, and this may have been the reason for pulling it before quite ripe, although I have elsewhere seen it stated that the fibre in this stage was softer and more elastic than when fully mature.

However that may be, I am confident from Mr. WELLS' experiment that a fibre can be procured from ripe flax fully suitable for the great bulk of household linens, if not for handkerchiefs and shirt collars, and the question is, how is the New England manufacturer to utilize it. Mr. SHEEHAN proposes to attack the flax crop of Missouri and Kansas, Mr. LAMONT that of Oregon and Washington, and both say that thousands of tons of fibre can be easily produced.

How and where is this to be manufactured? It will not pay to ship four tons of straw East to get one ton of fibre, and to save waste the retting and scutching must be done on the spot, and the fibre can then be bundled, baled and shipped to the eastern mills, or a linen industry grow up in the western and and Pacific states. It would seem from Mr. LAMONT'S letter that he expects to take the straw from the reaper and free it from its seed, while keeping it unbroken in the original bundles, and Mr. SHEEHAN appears to have the same plan in mind, so that hand pulling is to be dispensed with and the gathering done by machinery.

How far machinery has now been applied to retting and hackling, I do not know, but I have no doubt that Yankee ingenuity will be applied to it, and perhaps produce as good results as it has in the case of tin plates.

I have already said that I saw no difference in the flax ma-

chinery in Patterson, 25 years ago, from what I saw in England in 1850, and it may be that improvements can be made there, such as the Indian Orchard metallic drawing roll, for instance. The first great need today seems to be a sufficient movement of capital and energy to secure an adequate supply of fibre.

The PRESIDENT. Owing to the lateness of the hour and the fact that it was designed to devote a short time to giving the members an opportunity to getting acquainted with each other, we will defer any further discussion of this matter until tomorrow morning. Before closing I want to urge all of the members, so far as practical, to give us their attendance during the hours of the meetings in the mornings. The afternoons will be given up for amusement and sightseeing. All of those proposed for membership have been cordially invited to attend and participate in the discussions of all of the papers that may interest them. Before closing the Secretary has a few notices to give, after which the session will be considered as adjourned until nine o'clock tomorrow morning.

The SECRETARY. The first matter on the programme for tomorrow morning — that is, after any further discussion of Mr. NORTH'S paper — will be the discussion of the paper on "Cotton Yarn Mill Costs," read by title at the last meeting; and if any gentlemen wish to obtain copies of this paper to look over this evening they will find them on the desk after the adjournment. We also have a number of lists of members, which are a reprint of the first portion of the Transactions, and which may be a convenience to you for office work, particularly for the associate members.

The Board of Government has provided badges this time for all, the one consisting of a coat stud for the members and the other for the guests which is a pin, to be used by either ladies or gentlemen guests.

During the Philadelphia meeting the Bourse struck a medal in aluminum in honor of the visit of the New England Cotton

Manufacturers' Association. Some of those medals were left over, and that surplus has been sent to the headquarters of the Association for distribution among the members at this meeting. , You will find them in tiny envelopes in that box on the radiator, and you are invited to freely help yourselves.

The Secretary wishes to know as far as possible the names of all those in attendance, whether they are guests or members, and although they were given to all on the special trains coming up, those who came on other trains can obtain their badges at the desk.

The meeting then adjourned until Wednesday morning at nine o'clock.

SECOND SESSION.

WEDNESDAY MORNING, SEPTEMBER 26, 1898.

The Association met in the parlors of the Crawford House at nine A. M., President KNIGHT in the chair.

The PRESIDENT. The hour has arrived for our assembling. At our adjournment last night the speakers that had been scheduled to discuss the paper on "The Linen Manufacture in New England" had all made their remarks, and we left the matter open for any members to make inquiries or to extend remarks, and if there is anything further to be said on that subject it will be in order now. If there is no more to be said on the linen question the first matter on this morning's programme is the discussion of the paper on "Cotton Yarn Mill Costs," presented at our last meeting by Mr. WILLIAM WHITTAM, Jr. of Charlotte, N. C.

The SECRETARY. Mr. President, this paper was designed by the author to be read by the members by themselves, as on account of the large amount of statistical information and tables which it contains, he did not consider it adapted to presentation in full before the audience. It was presented by title and not read, at the request of the author, at the 64th meeting of the Association, held in Boston, and made a part of the Records

and published in the last Transactions, Volume 64, page 250, with a view that it should be brought up for discussion at this meeting of the Association. In connection with this subject of cotton mill costs it might be pertinent at this time to allude to the fact that at the 56th meeting of this Association, held in April, 1894, there was a report of a committee on costs of weaving. The committee was a very strong one and devoted a good deal of time, individually and as an organized body, to the subject. The amount of travelling which the members gave and reported to the Treasurer, my predecessor, in connection with the work of the preparation of that report, amounted to 1500 miles. This report was contained in Volume 56 of our Transactions, and one of the members of that committee said at the Profile meeting two years ago that the committee felt that they were slighted by the method in which that report had been received, and I was enabled to illustrate what I believed to be the feeling of the Association by the story of the little child who was chided by its mother for not thanking the lady for the candy; he said he did thank her for the candy, but he did n't tell her so. Now the Association have evidently thanked that committee for their exhaustive report, even if they never told them so, because there have been demands on the headquarters of the Association for that report, until we are down to five copies and the Board of Government have made a rule that the Treasurer shall not sell any copies at any price; and to that extent the headquarters have maintained a circulating library, which consists of five copies of Volume 57. There are three of them out at the present time. I hope that during the coming year the financial condition of the Association will be such that we will be able to reprint that report. It is not a very large one and there are not any engravings in it. Those earlier engravings, or those previous to Volume 57, have all been either burned or lost.

Mr. WILLIAM B. HAWES. May I ask the Secretary the names of those on the committee?

The SECRETARY. Messrs. A. M. GOODALE, HENRY F. LIPPITT, WILLIAM J. KENT, EDWARD W. THOMAS and RUSSELL W. EATON.

Mr. STEPHEN N. BOURNE. I wrote to Mr. HENRY F. LIPPITT inquiring about it, thinking that he wrote the paper, and he replied that he did not; but Mr. LIPPITT made some remarks which were not reported in that book.

Mr. WILLIAM B. HAWES. Was not that the paper that was discussed at the Institute of Technology?

Mr. STEPHEN N. BOURNE. Yes. I was very much interested in what Mr. LIPPITT had to say at that time, and I wrote him asking if he had a copy, and he referred me back to this book. But he made the remark, as I remember, about making up the mill costs, that the proper method was to take every department and imagine that you put the whole mill on that kind of goods.

The PRESIDENT. Are there any remarks to be made on this subject of cotton yarn mill costs? Has any one anything to say?

Mr. LOUIS SIMPSON. Mr. President, I read this paper in the copy of the Transactions which I received at Valleyfield, and last night I read it again. It is a very able paper in many respects, but I am afraid it has hardly given many of our members just the information they want. It is not a question so much of the theoretical production of a mill but it is the actual production that the management of the mill are able to get out of it that governs the cost, and the writer has based it entirely on their theoretical production, and upon mills also which are making special yarns. Now, all of us here who are spinners know very well that it is one thing to spin, say, a 40 twist down to 30s, and another thing to spin up to 50s. I thought after reading the paper through again last night that it might interest some of our younger members to narrate the system

that we had at the mill in England where I was an apprentice. We had there a spinning and weaving concern, but they were kept quite separate and separate books kept for each. In the spinning department we had a book called the digest, and in that book every week was entered the production of the yarn as taken off the spindle dry — it was all mule spinning. The card room wages were worked out to the cost per pound, also the spinning wages to the cost per pound, and then the sundry wages, such as engineers, firemen, warehouse men and clerks, which were put in a third column, and the cost per pound. There were also put down the average hanks per spindle and the average counts. At the end of the half year the owner of the establishment used to work up the result himself, and he could tell exactly how much waste he had made from the bale up to the spindle point, how much he had gained through water in the warehouse, and he knew exactly the cost for the half year in each department. Then they kept a very complete system of all the different stores used and general expenses, such as for banding, belting, oil, tallow, coal, etc., and he could tell you exactly to the decimal point how much had been spent that year and every year that the mill had been working. Such a system as that, I think, is more valuable than what Mr. WHITTAM has presented, and it seems to me the only way in which anybody can get at the exact cost of spinning. It is a simple matter in spinning to get the exact cost, but the cost will vary according to the quality of the yarn that you seek to make. I do not see how you can fix any one cost in the spinning department, because I know some people who would very much rather spend half a cent a pound extra in the card room than to pay a cent on their cotton and still get the same result. I have known some cases of that sort in England, in the spinning of yarn to be used for the manufacture of cotton velvet, where they run all their carding machinery very much under the usual speed at which people in the same town ran, and they always assured me that it had paid them.

The PRESIDENT. The meeting is open for remarks from any one interested.

Mr. STEPHEN N. BOURNE. In the matter of getting the cost of carding and spinning, the stumbling block is the general expense and the question of where to put that. If you are simply spinning yarn and stop there, of course you know; but if you are going on and weaving it and twisting it, what is the unit? I think Mr. WHITTAM is right about the unit to the spindle — what deduction there should be.

The PRESIDENT. Well, as I understand this paper, it simply stops at the mill yarn costs; it does not include the weaving department.

Mr. STEPHEN N. BOURNE. But in the table here he goes one step further — twisting.

The PRESIDENT. Yes; well, that would come into the yarn costs.

Mr. STEPHEN N. BOURNE. Well, I know, but in this table, as I understand it, in the twisting he puts the same general expenses that he did in the spinning, and if he should go on to the weaving would those general expenses come in again on Table 3?

Mr. LOUIS SIMPSON. I think Mr. BOURNE is quite right there, because I know of a case in England where they have a spinning and weaving concern and print works, and for many years the whole cost of the coal was charged to the print works.

The PRESIDENT. Mr. BOURNE may know something about that himself. It is a very well known and acknowledged fact that circumstances and conditions have very largely to do with making up the costs of cotton spinning, and while one party forms his opinion upon one basis, another might form his en-

tirely upon another. It would be interesting if we could get an expression from the various members as to their own ideas and methods of making up the costs. I should be very glad if each one would freely express himself. This is a meeting for that purpose; we come here to spend the first part of the day in discussing such questions as these, and for recreation in the latter part of the day. A general expression of opinion is the only way to make the meetings interesting.

Mr. STEPHEN N. BOURNE. Some mills, you know, make up their general expense and put it in the looms at so much a loom. If a mill is weaving on one kind of work alone that method, perhaps, is just as well as any; but in the case of a mill that is making more yarn than it weaves, the owner will sell some of his surplus yarn at a price which nobody can meet unless he sells it at cost without including the general expense, and the man who has to include the general expense gets left. It seems to me that the spindle is the proper place to figure from. Put your general expense into your spindles; there would be that factor to come in. Perhaps if you are selling yarn the general expense that goes to the looms would go into your yarn.

The PRESIDENT. This seems to me a very important question, and there ought to be many opinions in regard to it.

Mr. STEPHEN N. BOURNE. I think it is one of the most important questions that we have had, especially when things are down as fine as they are now.

The PRESIDENT. I so regard it.

Mr. WILLIAM B. HAWES. Mr. SIMPSON spoke of a book which they kept in a mill with which he had been connected. Supposing that they should stop on the spindle, put the general expense on the spindle, and then they twisted that yarn, should you say the general expense should be charged if half the product was twisted and the other half sold single?

Mr. LOUIS SIMPSON. I would take the doubling department as a separate concern, and whatever expense was properly due to that department should be charged to it. Of course I can understand Mr. BOURNE'S point. It is very awkward where we have a concern that does both weaving and spinning, and I know how extremely awkward it is, because I am placed in the same position myself; but generally when I make up my costs for spinning I take the basis of the Oldham (England) mills. It comes near enough to answer my purposes. But I do not see how it is possible for any concern to get at the true cost unless they conduct their departments separately; that is to say, make some kind of an arrangement by which the general expenses are fairly divided, and then take the cost at spindle point, and then at the bobbin for double yarn, and afterwards for the weaving. That is the way I would strongly advice any one to try to do. But of course you must divide your expenses fairly; you must not put the expenses that are common to the whole concern upon one department, or else you will make that department suffer, and you will on one department be spinning or manufacturing too dearly, while on the other departments you will be manufacturing too cheaply, and in that case you deceive yourself.

There was one thing in this paper which struck me as very good. Mr. WHITTAM says that you ought to charge up the depreciation. On that point Mr. WHITTAM is quite correct. They do that in England, and I think it is to the interest of us all that it should be done. We have mills that do not do it, and they think they are making money, and the time comes when their capital is wiped out, and meanwhile, if you are taking off depreciation in your own mill you are competing against a man who is selling on a lower basis of cost. It is true, perhaps, that you are saving your capital while their capital is going, but still it brings to you undue competition. It is one of the many things, I think, that you are suffering from today, and it is one which, I think would be well worth the attention of the members

of the Association, and I think the more they look into it the more important they will find it.

Mr. STEPHEN N. BOURNE. I think the usual method is not to charge off depreciation as such, but to charge a certain percentage to repairs and improvements. When new machinery is put in it is charged to repairs. You reach the same result — you keep your plant up.

Mr. LOUIS SIMPSON. If the Association would like, at the next meeting, if I am able, I will bring one of these English forms, showing how a concern that I know well works these details out.

[The following statistics have been furnished by Mr. SIMPSON since the meeting. — *Secretary.*]

Accounts for a weaving concern during 3 months, 450 looms, on Piece goods, for converting, average counts used, about 40's.

Interest,	$172.00	Shuttles and Bobbins,	$33.00
Sundries,	22.00	Ropes and Twines,	28.00
Carriage,	578.00	Leather and Strapping,	166.00
Travelling Expenses,	43.00	Pickers,	70.00
Printing and Stationery,	36.00	Stamps, etc.,	12.00
Coal,	283.00	Brushes,	9.00
Commissions,	860.00	Auditors,	10.00
Insurance,	13.00	Repairs,	226.00
Oil and Tallow,	62.00	Discounts,	372.00
Sizing,	761.00	Directors,	87.00
Healds and Reeds,	51.00	Wages.	7,863.00
Gas and Water,	192.00		

Costs in a fireproof mill which contained 65,000 Mule Spindles, costing $5.50 a spindle. No Looms.

Amounts Paid for 1 Quarter.

Brokerage and Charges,	$625.00	Gas and Water,	$240.00
Carriage,	1150.00	Insurance,	205.00
Coal,	1385.00	Interest,	2820.00
Oil and Tallow,	620.00	Bank Charges,	40.00
Brushes,	25.00	Commission,	1755.00
Banding,	230.00	Discounts,	1765.00
Paper and Twine,	65.00	Rates and Taxes,	470.00
Strapping,	85.00	Depreciation,	3940.00
Roller Leather,	110.00	Printing and Stationery,	20.00
Roller Cloth,	35.00	Petty Cash,	75.00
Repairs, Buildings,	75.00		
Repairs, Machinery,	170.00	*Contra.*	
Skips and Bobbins,	30.00	Yarn,	$125,575.00
Mill Charges,	65.00	Waste,	2,815.00
Stores,	130.00	Sundries,	45.00

Particulars of the Cost of Spinning in a mill containing only Ring Frames.

Interest,	.552 per lb.
Depreciation,	.480 " "
Repairs,	.048 " "
Coal,	.170 " "
Banding,	.006 " "
Brushes, Travellers and Bobbins,	.032 " "
Oil,	.032 " "
Carriage,	.128 " "
Rates and Taxes,	.048 " "
Insurance,	.032 " "
Discounts,	.208 " "
Commission,	.032 " "
Gas,	.032 " "
Roller Covering,	.032 " "
Sundry Disbursements,	.032 " "
	1.864 " "

Or about 1⅞ cents per lb. for 30's Twist.

Mr. STEPHEN N. BOURNE. How do they get at their costs when they have spinning and weaving in the same concern?

Mr. LOUIS SIMPSON. They generally divide the two concerns separately. I am talking of a private concern. Most of the public concerns in England — companies — either do spinning or weaving only; those concerns which do both are usually private concerns. They generally keep two sets of books; the yarn that is spun in the spinning department is charged at market price to the weaving department.

Mr. STEPHEN N. BOURNE. Which makes the money?

Mr. LOUIS SIMPSON. Sometimes one and sometimes the other. You see when you have money in both pockets it is not very much matter whether the left pocket holds the money or the right.

Mr. STEPHEN N. BOURNE. You want to be sure and get it in one or the other.

The PRESIDENT. Would it not be a proper method to ascertain the costs if the actual expense of each loom was charged up to itself, and then the general expenses charged up per rata?

Mr. LOUIS SIMPSON. You can do that if you are weaving all the same cloth, but if you are weaving a hundred different sorts in the same mill, a loom weaving on some of these sorts will cost a great deal more to run than a loom weaving on some of the other sort, and therefore the basis of price per loom would not apply.

The PRESIDENT. Well, then we would fix the basis upon the general cost of weaving, and the point that I wanted to make was, in getting at whether the general expense should be charged to the yarn or to each department, whether it would not be proper to take the general expense outside of the various rooms and charge up pro rata — that is, in proportion to the

actual cost in each room; whether that would not be a fair way of arriving at the general cost?

Mr. LOUIS SIMPSON. The system that I use at Valleyfield is to divide my general expenses in different proportions. I do not say that the proportions are correct, but I use my best discretion. I put a certain proportion of the repair costs every fortnight into spinning, so much into weaving, so much into dyeing and so much into finishing. It comes near enough for my purpose. Then when you have found the cost of the yarn, if you are weaving yourself, you take the sale value of the yarn on the market and add to that the ascertained cost of manufacturing, and that gives you the cost of your cloth, the cost of weaving being ascertained by the Blackburn method, which is so many times the weaving price, in accordance with the experience in that special mill. It is utterly impossible to find any perfect way of getting the cost on the goods in any mill where a great number of sorts are being made.

The PRESIDENT. Have we not some one else who has an opinion to express on this matter?

Mr. JOHN ECCLES. Mr. President, this matter of costs, as Mr. SIMPSON says, is a very difficult one, but it seems to me that the proper method would be to take the wages of the overseer, the second hand, the section hands and other day help, whatever you have in your weaving room or rooms and sum them all up together, and then divide the number of looms by that amount, which would give the expense pro rata for each loom. Now, some loom fixers run less looms on more difficult work than others that are running, which would incur additional expense per loom for the loom fixer only, to be added to the other expense. There is a vast difference, dependent on the product and the style of fabric being woven and the counts of yarn used, in the price of labor paid to the weaver, which will have to be figured per pound independently. Some would be double

others. For instance, if you are paying 50 cents per cut for one style and a dollar for another, there is a vast difference per pound or per yard for the weaver's labor. This method of estimating would, it seems to me, give with the utmost accuracy the cost per pound or per yard of each fabric woven. I do not see any way of reaching an accurate result, except to add that additional expense per pound to the cost of weaving. This does not include supplies, cost of power, or the general expense of office work, etc. It simply covers the weaving department. The expense for overseers, second hands, etc., is no more proportionately whatever work the loom may be weaving. For instance, we have two or three hundred different kinds of cloth weaving at the same time, and it costs no more for overseer's service in one case than another. If anybody wishes to figure in the power he can do so; if one room takes double the other, allowance can be made for it.

The PRESIDENT. The next paper is one which was prepared by invitation by one who was not a member at the time, but who joins the Association at this meeting, and treats upon what is virtually a new cotton product by the skilful application of an old process. Mr. J. R. MONTGOMERY will now read his paper on "Mercerized Cotton."

MERCERIZED COTTON.

J. R. MONTGOMERY, Windsor Locks, Conn.

The subject of mercerized cotton has aroused a good deal of interest among textile workers for some months past. The fact that European chemists had for some time been able to produce a lustre upon cotton yarns that rendered them difficult to be distinguished from silk became known in this country about two years ago, but it was some months later before it was found that this result was produced through an adaptation of Mercer's process, which was discovered by John Mercer, a cotton printer of Lancashire, England, as early as 1844. He made his discovery the basis of broad patents which were issued to him in England and in continental countries in 1850.

A reading of his claims in the original patent application will show that it was no part of his purpose to produce cotton yarns or fabrics of the high, silk-like lustre now obtained by the so-called mercerizing process.

To quote from his application, "The invention consists in subjecting vegetable fabrics and fibrous materials, cotton, flax, etc., either in the raw or manufactured state, to the action of caustic soda or caustic potash, dilute sulphuric acid, or chloride of zinc, of a strength and temperature sufficient to produce the new effects, and to give the new properties to them which I have hereafter described.

"The mode I adopt of carrying into operation my invention to cloth, made wholly or partially from any vegetable fibers, bleached, is as follows: I pass the cloth through a padding machine charged with caustic soda, or caustic potash, at 60 or 70

degrees Twaddell's hydrometer, at the common temperature, at say 60 degrees F. or under, and, without drying the cloth, wash it in water, then pass through dilute sulphuric acid and wash again, or I run the cloth over and under a series of rollers in a cistern with caustic soda or caustic potash at from 40 to 50 degrees of Twaddell's hydrometer, at the common temperature of the atmosphere, the last two rollers being set so as to squeeze the excess of potash back into the cistern; the cloth then passes over and under rollers, placed in a series of cisterns charged at the commencement of the operation with water only, so that, at the last cistern, the alkali has been nearly all washed out of the cloth; when the cloth has either gone through the padding machine or through the cisterns above described, I wash the cloth in cold water, pass it through dilute sulphuric acid, and wash it again in water.

"When I adapt the invention to gray or unbleached cloth, made from the fibrous material before mentioned, I first boil or steep the cloth in water, so as to have it thoroughly wet, and remove most of the water by the squeezers or hydro-extractor, and then pass the cloth through the soda or potash solution, etc., and proceed as before described.

"I apply my invention the same way to warps, either bleached or unbleached. By this process I produce on cotton and other vegetable fabrics and fibers, effects somewhat analogous to that which is produced on woolen by the process of fulling or milling. It will have acquired greater strength and firmness, each fiber requiring greater force to break it. It will also have become heavier than it was before it was acted on by the alkali, if in both cases it be weighed at the temperature of 60 degrees F. or under. It will have acquired greatly augmented and improved powers of receiving colors in printing and dyeing.

"The effects of the application of my invention to the vegetable fiber in any of its various stages before it is manufactured into cloth will be readily understood by reference to its effects upon cloth composed of such fibers."

He also described secondly and thirdly two other processes

for producing the same effect. By using diluted sulphuric acid in the one instance, and solution of chloride of zinc in the other, neither of which are of practical value and need not be considered at this time.

He then proceeds. "When I operate on mixed fabrics, partly of vegetable and partly of silk, woolen, or other animal fibers, such as delaines or leans, etc., I prefer the strength of the alkali not to be above 40 degrees Twaddle's hydrometer and the heat not above 50 degrees F., lest the animal fibers should be injured.

"I may, in conclusion, remark that the description of the apparatus or machinery and the strength and temperature of the soda or potash, sulphuric acid or chloride of zinc solution, may be varied to a considerable extent, and will produce proportionate effects without at all deviating from my invention. For instance, caustic potash or soda may be used even as low as 20 degrees Twaddell's hydrometer, and still give improved properties to cotton, etc., in receiving colors in printing and dyeing, particularly if the heat be low, for the lower the temperature the more effectively the soda or potash acts on the fibrous material above described. I, therefore, do not confine myself to any particular strength or temperature of the substances I employ, but the particular strength, heat, and processes here described are what I have found the best, and what I prefer.

"And I claim as of my invention the subjection of cotton, linen and other vegetable fibrous material, either in the fiber or any stage of its manufacture, either alone or mixed with silk, woolen or other animal fibrous material to the action of caustic soda or caustic potash, dilute sulphuric acid, or solution of chloride of zinc at a temperature and strengh sufficient to produce the new effects, aud to give to them the new properties above described, either by padding, printing or steeping, immersion or any other mode of handling."

It will be seen that Mercer's invention was for the purpose of producing in cotton goods a fabric that would be somewhat analogous to fulled or milled woolen goods, the fabric to be-

come heavier and of greater strength. But principally, and this is the point upon which he lays the greatest emphasis, "It will have acquired greatly augmented and improved powers of receiving colors in printing and dyeing."

I have recently seen the translation of an article printed in a German textile paper more than 40 years ago. It is headed, "Process for obtaining fine and contracted cotton goods". "Very curious, and of great value, not only for cloth printing, but also for obtaining fine linen and cotton goods of all descriptions, is the discovery on which Mercer has taken a patent, in the year 1850." It goes on with full particulars of the claims under the patent, and of the structural change which takes place in the fiber itself as shown under the microscope. It does not allude in any way to an increased lustre of the fiber, nor will Mercer's process produce a lustre.

Mercer's anticipations of the value of his discovery were never realized, for the contractions of the cloth in all directions after passing through his process made them more expensive, and the advantages gained were more than overcome by their increased cost of production, so that the process was for many years practically forgotten.

The next application of the process was in the manufacture of silk, and of worsted crepons, a light dress fabric, a distinctive feature of which is its crepe or crinkly effect produced in weaving. Goods of this description are made that are washable and that will not lose the crepeness through washing, and are commonly dyed in plain colors.

These goods were very popular and the height of fashion for ladies' wear some four to six years ago. They were woven with two warps, a back and a face, the back warp being tight under a severe tension, and the face warp loose and slack. This, with the peculiar weave, produced the crinkly or crepe effect.

Foreign goods were soon brought into market that had this peculiar crepe effect greatly exaggerated into large puffs, which took the popular fancy and drove their more modest predecessor out of the market. The domestic manufacturers were unable

through any of their arts of weaving to produce these more pronounced effects.

Examination showed that the back warp was of cotton sparsely scattered across the width of the goods and that filling threads were also thrown on the back in regular or irregular patterns as desired, and it was only too late, and not until fickle fashion had bowed down to some other idol, that it was discovered that the much sought after effect had been produced by passing the goods with its cotton back and worsted or silk face through the mercerizing process, shrinking the cotton in all directions from 20 to 25 per cent., throwing the face of closely woven animal fiber, which was unaffected by the cold caustic alkali, into great puffs and blotches.

Later, a firm of German dyers, experimenting on some half-silk and cotton goods which they desired to piece-dye, found that the cotton did not take the dye with the same intensity as the silk. They concluded to mercerize it, and, to prevent the loss in the cotton by shrinkage, determined to put it through the concentrated solution of caustic soda in a strongly stretched condition. Their experiment was a perfect success. They found they had achieved all they desired, and, to their astonishment, that the cotton had assumed a lustre equal to that of silk. They developed this discovery into a process to produce the silk lustre upon cotton now known as mercerized cotton, silkoline, sub-silk, silk-lustre, etc.

An attempt was made by them to patent this process in England but the English Patent Office refused on the score of anticipation, and as there is now no restriction to its use, the process is becoming quite general.

To obtain this silk lustre the general method to be pursued is as follows: Skein yarns, warps or piece goods in a stretched condition are immersed in a solution of caustic soda for about twelve to fifteen minutes in a strength of bath about 50 degrees Twaddell. The goods are then lifted, and the surplus liquor is removed either by squeezing the goods through rolls, putting them through the hydro-extractor, or any other process to re-

move the excess of alkali. They are then thoroughly washed with clear water. A second bath of diluted sulphuric acid neutralizes all remaining alkali, when a final rinsing leaves the goods in condition for either bleaching or dyeing. As a result of the uniform contraction of the fiber under tension, and of the chemical change of the fiber itself, the goods have a tensile strength of from 15 to 25 per cent. greater than before treatment.

The ordinary cotton fiber under a microscope reveals itself as an irregular, flat, but twisted ribbon. The moment, however, that the caustic soda touches the fiber, it untwists, contracts, and swells, taking a firmly rounded form. The fiber retains this rounded form after the caustic soda has been washed off, and through all subsequent treatment.

The question is invariably asked when showing this product, is this silk-like lustre permament? Will it remain after bleaching and dyeing? The reply is that the lustre is permanent and will not be affected by any subsequent treatment. It can be so covered with starch, china clay or other extraneous matter as to be obscured, or it may be so dyed as to leave a precipitate upon the goods or yarns that will obscure the brilliancy of the luster, but these removed, the silk-like gloss is still there.

It is often asked, why does the mercerized cotton take on this high lustre? The best reply to this question is that the cotton, through the action of the caustic soda, is brought to a gelatine or parchment-like condition, the extreme tension rounds and concentrates the fibers so that the rays of light as they fall upon them are reflected instead of being absorbed. The quality and degree of lustre and the silk-like appearance is largely dependent upon the quality of the cotton used.

Long-staple Egyptian and Sea Island cotton, so twisted as to leave the fibers as nearly as possible loose and parallel, show the best results. If the yarn is gassed, removing the ends of the fibers, the result is a further improvement.

To what uses may this new product be put? I cannot do better than to quote an extract from a letter dated Leeds, Eng.,

February 12th, 1898, and published in the Cotton and Wool Reporter, March 3. The writer says: "For a long time there has been a feeling in the textile industries for a new fiber or some invention or adaptation of the old fibers, wool, cotton, silk, etc., which would produce at any rate a new cloth. Men in the trade who possessed a scientific knowledge have made experiments with various substances, each hoping to strike something which would create a new fabric and lead him on to fortune in the same manner that TITUS SALT, who founded the great firm in England and in the United States, discovered the capabilities of the hair of the Alpaca and Angora goat.

"At one time ramie fiber was to revolutionize the trade; then it was China grass; and I know a manufacturer who even made a length of cloth from human hair. None of these, however, proved successful.

"It seems at last that something has been discovered, or rather, I should say, applied, which is bound to have an important effect on the cotton industry. I refer to the new mercerized cotton, which is the closest imitation of silk that has been put on the market for years."

He predicted that next season the dress-goods makers would show exquisite designs and effects with this mercerized cotton. The prophecy was more than realized, and those manufacturers who used this product in their goods were amply rewarded for their enterprise.

The coming season will show mercerized yarns in a vastly larger variety of material and styles than last season did. Large ranges of samples have been used in underwear and hosiery, cotton and worsted dress goods, cotton shirtings, half-silks, printed light silks, linen dress goods, etc.

Is it not well to call the attention of this Association to the necessity of a diversity in our line of cotton manufacturing? Staple goods have become a drug upon the market because the consumption does not keep pace with the production. The southern mills, with their cheaper labor and longer hours, are pressing hard in the race for the markets. We are struggling

for existence and expending our energy and ability in increasing the speed of our spindles and of our looms. We are stunting our sensibilities in squeezing down the cost of labor, yet we are in doubt whether the winning is for us.

Would not the same energy and ability that is shown in the lines indicated, if directed towards a diversifying of manufactured products, produce infinitely better results. There is room at the top, though at present it is largely filled by our enterprising English, German and French friends.

Mercerized cotton is a new product. It has come to stay. It increases the scope of the designer and adds beauty and finish to his work at a comparatively low cost. I am pleased to present for your examination a line of samples which will illustrate some of the merits claimed for this new product.

[A large number of samples of cloth and yarns made of mercerized cotton were passed around for inspection.]

The PRESIDENT. If any party has any question to ask of Mr. MONTGOMERY, he is at liberty to do so at the present time. We would prefer those questions to be put in such a manner that our stenographer can get the questions and answers.

Mr. JOHN ECCLES. Mr. President, if I understand Mr. MONTGOMERY aright, he says that this process adds strength to the yarn. Does he mean to say that if the cotton is mercerized after it is spun and before the yarn is put into cloth, it will add strength to the yarn?

Mr. J. R. MONTGOMERY. Yes, sir.

Mr. JOHN ECCLES. That is a very important question. I would like to ask also if cotton has ever been mercerized before it has been carded?

Mr. J. R. MONTGOMERY. I think it would be impossible. It would full together, the same as a batch of wool in a fulling mill.

Mr. PERCY H. BRUNDAGE. I would like to ask whether in mercerizing cotton yarn it does not frequently obtain the gritty feeling or crinkle that is in silk?

Mr. J. R. MONTGOMERY. That is an after process, the same as it is in silk. The same is true in silk as it is in mercerized cotton. What they call the scrimpy feeling is put on through an acid and soap process.

Mr. PERCY H. BRUNDAGE. When that is put on, does it retain it?

Mr. J. R. MONTGOMERY. It does not, neither does silk.

Mr. STEPHEN N. BOURNE. In how large skeins is it practicable to have this yarn put up in before it is mercerized?

Mr. J. R. MONTGOMERY. Well, the yarn that you have in your hand [indicating] was put up in 90-inch skeins, and there was at least a pound in each skein.

Mr. STEPHEN N. BOURNE. You do not have to go to the trouble of putting it up in 3-ounce skeins?

Mr. J. R. MONTGOMERY. Not at all. This was put up in 90-inch skein, weighing about a pound each.

Mr. JOHN ECCLES. I would like to ask Mr. MONTGOMERY another question. The fibre that is on the thread — you spoke about gassing.

Mr. J. R. MONTGOMERY. Yes sir.

Mr. JOHN ECCLES. When there is a fibre on the thread does it make it so it would cling to other threads more after it had been mercerized, or will it less?

Mr. J. R. MONTGOMERY. No, not at all. Before mercerizing we advise singeing off the fibres that stick out at the end, but if they are left on they draw in, they contract, and you do not see as much of them, but they are not apt to catch on to anything.

Mr. PERCY H. BRUNDAGE. Does that added strength remain in the fabric?

Mr. J. R. MONTGOMERY. Always. You have made a structural change in your fabric itself. You have contracted it, you have drawn it together and rounded it, so that the fibre, instead of being flat is as round as a hair, and it is so contracted and drawn together that you have increased its strength. The fibre is drawn together tightly.

Mr. PERCY H. BRUNDAGE. And that stays in the fabric even after washing?

Mr. J. R. MONTGOMERY. Through any process.

The SECRETARY. I have a discussion on the paper by Mr. FRED LACEY, who wished me to read it for him in his absence from this session, although Mr. LACEY is present at the meeting but is not in the room at this time, I believe. For this able paper as a part of the programme we are indebted to a member, Mr. LOUIS SIMPSON, who referred to mercerized cotton at the semi-annual meeting at Philadelphia, and on consultation with men acquainted with the business in the endeavor to obtain a paper on the subject of mercerized cotton from one who is thoroughly familiar with this new subject, I was informed,

and the remarks of the speaker of the occasion show that I was correctly informed, that Mr. MONTGOMERY was the leading expert on this subject in this country. I have here some of the mercerized spindle banding which has been brought by Mr. MONTGOMERY, and it is quite new and has not yet received a long and practical trial, but is something which, I believe, will be worthy of your very careful consideration. Shall I pass the samples of spindle banding around? [Passing the sample to the members.]

Mr. FRED LACEY. The durability of spindle banding is no new question. Cotton spinners who make quantity and quality a matter of earnest consideration, have at all times made the durability of the spindle banding they used a matter of more or less anxious thought. In England it is usual for the cotton spinner to purchase the spindle banding he is using from a spindle banding manufacturer, who generally manufactured the article he sold out of waste or so-called soft or nicked cops. In the States it is usual, or at least general, for cotton spinners to make the spindle banding they consume. The Messrs. Draper Co., of Hopedale, Mass., have done much in the endeavor to impress upon the trade the importance of using durable and well made spindle banding. To Messrs. Draper the thanks of all live cotton men are due because the quality of the spindle banding used has no little to do with the success or failure of every cotton mill. It is not only a question of economy as regards the money annually spent to replace worn out bands. It is not so much a question of the power used by spindles banded this way or that way, or with this band or that band, although this is a matter of considerable importance, but the question is, will a band of a certain excellency enable the spinner to produce yarn which is superior to yarn produced on spindles actuated by spindle bands manufactured from inferior materials or upon other systems?

A year ago at Philadelphia Mr. LOUIS SIMPSON suggested to this Association that the Directors be authorized to arrange

for the expenditure of such moneys as might be needful to secure the requisite experiments to prove or disprove whether mercerized spindle bands were an improvement over the old fashioned band.* Mr. SIMPSON'S idea was not approved by the members of this Association as assembled at Philadelphia. Perchance the lavish hospitality of the good fellows of the City of Brotherly Love may be responsible for the cold reception of a new idea. However, on his return home Mr. SIMPSON asked me to take charge of the experiments he had in vain asked the New England Cotton Manufacturers' Association to take charge of, and I have now the honor of placing before the members of that Association the results.

I have taken four ring frames, English make, with double cylinders, two old frames and two new frames and the result is as follows:

Old Frames.	*Bands broken in a given time.*
Unmercerized bands,	20
Mercerized bands,	1
New Frames.	
Unmercerized bands,	70
Mercerized bands,	17

I claim for the mercerized bands, fewer bands used, less power expended and better yarn made.

The PRESIDENT. Are there others who would like to take part in the discussion of this important subject? Is Mr. JOHN BELL here?

The PRESIDENT. Mr. KITTREDGE?

Mr. HENRY G. KITTREDGE. I am not a member of the Association.

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*Transactions, Volume 63, page 215. "I would suggest that this Association give a prize so that it would induce some chemists to make experiments as to the benefits found out in that line."

The PRESIDENT. We should be glad to hear from you, however, if you have any remarks to make on the matter.

The matter of the mercerized spindle band, according to reports, is one that ought to very deeply interest every spinner of cotton. Since we have adopted the fast running spindle, one of the serious drawbacks has been the slack twisted cotton, owing to the stretch of the band, and anything that tends to obviate that difficulty is largely for the interest of the manufacturer.

The SECRETARY. Mr. President, Mr. JOHN BELL has reached the room.

The PRESIDENT. Mr. BELL.

Mr. JOHN BELL. I would like to ask one question of Mr. MONTGOMERY, if he can give me any information in regard to it. We have tried some few experiments in regard to mercerizing of linen yarns, and speaking of the tendency of the yarn to contract, it leaves the linen yarn very much in the shape of cotton or woolen yarns as regards its elasticity; that is, it removes that great objection that has always been made as to linen yarns, of inflexibility. We have, then, after mercerizing a yarn that is as elastic as cotton or woolen. But a question that has arisen in my own mind, which I would like to ask — perhaps you can give me information with regard to it — is as to the linen retaining the property that it has now of absorption of moisture from the atmosphere, etc., giving it that cool feeling that we get from a linen sheet or from a linen shirt.

Mr. J. R. MONTGOMERY. I am not prepared to answer that question because I have not experimented in that direction. I have made experiments in mercerizing linen yarns. It was successful so far as the lustre was concerned. But so far as the properties of retaining its power of absorption and other qualities that linen has, I cannot tell; I do not know.

Mr. JOHN BELL. My object in asking that question is that

we all know that a linen sheet or a linen shirt is a very comfortable thing to have about us in the summer time. The one objection to the use of linen for underwear has been that inflexible property that it has, so that a man must be built in a pretty peculiar way to be able to get linen underwear on, and another thing, if he wears a linen sock, it is pretty hard work to get that linen stocking to take the form of anything but a straight stick. Now if with this mercerization we can get the property of elasticity and still rctain the other properties that linen has, it will have more or less influence.

Mr. J. R. MONTGOMERY. I think you are asking an impossibility; I do not think it is possible. The effect upon any vegetable fibre would be the same as upon cotton: it would contract it, and in the contraction you would lose rather than gain elasticity. There is less elasticity in mercerized cotton than there is in ordinary cotton.

Mr. JOHN BELL. Well, so far as our experiments have gone we have gotton all the elasticity we want in the linen. We have none when we start; we have any quantity when we leave off.

Mr. J. R. MONTGOMERY. Did you mercerize it under tension?

Mr. JOHN BELL. Well, under partial tension. The elasticity depends altogether upon the tension that we put on.

Mr. J. R. MONTGOMERY. Your object, then, was not to produce the high lustre?

Mr. JOHN BELL. Not altogether the lustre.

Mr. J. R. MONTGOMERY. I cannot answer you; I have not experimented in that direction.

Mr. JOHN BELL. That was what I wanted to find out particularly. We will carry our experiments a little further, and

perhaps another year we may be able to give some information upon that point.

Mr. LOUIS SIMPSON. I think, Mr. President, I can answer Mr. BELL on absorption. From my experiments I think the absorption would be quite as good as what he had before. I cannot answer him as to whether the coolness and elasticity of the treated linen would be permanent, but I would suggest that he make experiments and report at the next meeting of the Association.

Mr. JOHN BELL. Not at all. In fact, our object was to have some stockings and underclothing made from yarn treated in that way and see whether it would retain the elasticity and also retain the properties which linen has as a cool wearing apparel for the summer. That, perhaps, we will carry on further.

Mr. J. R. MONTGOMERY. On mercerized bands I have not tested them long enough to be able to say that they are going to be so much better than the ordinary cotton bands. I have a theory, and it is a theory only, that there will be hardly any elasticity in a properly made and mercerized cotton band, and that the bands may be put upon the spindle more lightly, or with just sufficient tension to drive the spindle, and they will remain there in that condition, and that you will be able to drive more spindles per horse power with the mercerized band put on carefully and properly, and I believe they will last a long time. I have been testing some a couple of months only, so that I am not able to tell how long they will wear, but so far as the stretching is concerned they have shown no signs of stretch up to this time. I believe this is the important point in the mercerized band.

Mr. LOUIS SIMPSON. I can fully endorse that, Mr. President, that is our experience; and more than that, the mercerized bands do not gather as much fluff as the unmercerized do. Anybody who has had experience in a cotton mill knows how much fluff will gather round the ordinary spindle bands.

But we find there is a distinct difference, and we find that they lose very little tension by the power scale after they have been worked some time, whereas on the ordinary band the power scale shows a very great difference in a very short time.

Col. JOSEPH H. KENDRICK. Mr. President, can any one give us the additional cost of mercerized bands, if any?

The PRESIDENT. Mr. MONTGOMERY, have you any idea of the additional cost?

Mr. J. R. MONTGOMERY. No, I have not gone into that matter. It is merely an experiment to find whether we have something that is good for anything. After that, of course, it would cost more.

Mr. JOHN ECCLES. I would like to ask, Mr. President, if they have ever tested a frame to ascertain the difference in horse power. It seems to me there must be a great saving in horse power by putting a band on so lightly that you do not have to pull it hard, because a cotton band which is not mercerized has to be put on pretty tight in order to have it stay in place and drive the spindle: and from the general remarks that a band can be put on very lightly indeed, not drawn tightly at all, but just sufficient to turn the spindle, it seems to me there must be an immense saving of power.

Mr. J. R. MONTGOMERY. I believe that is the important point. The usual way I have seen boys put on a band is to bring it up tight and give it three or four jerks and then let it run, and as the band stretched it would be about right.

Mr. FREDERICK A. FLATHER. Mr. President, how much does it add to the cost of yarn to mercerize it?

The PRESIDENT. That is a question that has just been asked but we are not able to answer it.

Mr. FREDERICK A. FLATHER. I think that was regarding the cost of the bands.

Mr. LOUIS SIMPSON. I believe, Mr. President, that we should not inquire into this too closely. I should judge that if a mercerized band is to be used by the bulk of the mills in this country, some one will have to make a business of making it, and it would be hardly right for me to give away his business. It is no interest of mine, and I would not mind telling you. The mills might make their own bands and mercerize them, but it would be impossible for the smaller concerns to do so. It seems to me it would be for the interest of every one to find one or more firms who could be prepared to manufacture for the trade.

The PRESIDENT. I believe Mr. FLATHER'S question was as to the cost of mercerized yarn; I misunderstood that question at first.

Mr. FREDERICK A. FLATHER. The cost of yarn, not of bands.

Mr. J. R. MONTGOMERY. I will give the gentlemen our price list, and we shall be glad to furnish quotations of prices to any member at any time.

Mr. FREDERICK A. FLATHER. How much does the loss in shrinkage amount to?

Mr. J. R. MONTGOMERY. The same as in the bleach; the effect is the same. It takes the vegetable oil out of the yarn, and it is anywhere from 6 to 8 per cent; it depends on how strongly it is bleached.

Mr. FREDERICK A. FLATHER. I was told a few weeks ago that it was cheaper in some fancy goods that are being made of cotton and silk to use silk instead of mercerized cotton. I would

like to hear what Mr. MONTGOMERY has to say about that, or any member present.

Mr. J. R. MONTGOMERY. I should like to know the authority. The cost depends, of course, upon the size of the yarn, but an ordinary No. 40 yarn, two-ply, would cost, mercerized, approximately seventy cents per pound for high grade work, while silk of the same size could not be bought for less than $2.50 per pound.

Mr. FREDERICK A. FLATHER. These goods contained a very small percentage of silk; it was entirely on the face of the goods, and whether it was in stripes or figures, or what, I cannot tell you, but the goods were being shown by one agent to another, and the matter of mercerizing cotton came under discussion. The maker said he had tried both, and after experimenting to a considerable extent and spending a great deal of money he had decided to use silk and is now using it, and he finds it a great deal cheaper and claims he can get about the same appearance as from mercerized cotton.

Mr. J. R. MONTGOMERY. I do not understand it.

Mr. STEPHEN N. BOURNE. Does this yarn have to be all doubled and twisted yarn?

Mr. J. R. MONTGOMERY. To get the lustre effect, yes, the same as any other lustrous fibre; if it is twisted tightly you do not get the continuous reflecting surface on your fibre, whereas if your fibre lies perfectly straight, no twisting at all, you get the reflecting surface the full length of the fibre, so that in making two-ply yarn you balance the twist so that the fibres lie parallel, and as it turns in the twist it lies parallel with the thread and gives you a reflecting surface. Single yarn does not show a high lustre in mercerizing, but if the same yarn is mercerized singly and then twisted afterwards so that the fibre will lie loose

and parallel with the yarn, then you get the reflecting surface, and therefore the lustre.

The PRESIDENT. Are there any further questions to be propounded in this matter? It strikes me as a matter of very great interest to all manufacturers — the matter of turning our cotton into silk, and also of getting a band that will prevent the slack-twisted yarn that has bothered us so much in the past, and evidently a great saving of power. Mr. BOURNE, had you something to say?

Mr. STEPHEN N. BOURNE. I was just going to ask if anybody was prepared to do this band business now in this country?

Mr. J. R. MONTGOMERY. Yes, sir, I can give you all the bands you want.

A MEMBER. Cheap enough.

Mr. J. R. MONTGOMERY. For experiment. [Laughter.]

The PRESIDENT. I should wish for the benefit of the Association that this matter might be continued to another meeting and new facts and developments may be brought out between this time and that, and it seems to me that it is a subject of so much importance that it should not be forgotten, and I hope it may interest some one member or more of the society to the extent that at the next meeting in April in Boston this same subject may be resumed and new papers presented which will give us more instruction in regard to the matter. I regard it as a very important matter.

If there are no further questions to ask our next paper will be read. It is by Mr. EDWARD D. WILBUR of Newberry, S. C., and will also be of great interest to us.

The SECRETARY. Mr. President, Mr. WILBUR writes me that he was unable to carry out his cherished desire of meeting with

the Association and renewing his acquaintance with you and with the White Mountains. Mr. WILBUR is a man originally from the state of Connecticut, who in the mutations of life has gone to the South and engaged in manufacturing there, and is able to look at the question involved in his paper from a broader and more cosmopolitan standpoint than any one whose career has been limited to any one section of the country.

SOUTHERN COTTON MILLS AND COTTON MANUFACTURING.

EDWARD B. WILBUR, Newberry, S. C.

As this subject has been thoroughly investigated by many members of the Association, it appears to the writer little if anything new can possibly be presented, but having consented to supply an article upon the subject, I do so fully intending to confine myself to data collected by investigation, correspondence and otherwise, which is presented unbiased by personal opinion. Very much of that written concerning manufacturing in the South, has been largely exaggerated, for which there is no excuse. In making that statement I refer to both Northern and Southern writers; for, if we were to credit all written, describing the advantages of the Southern Mills over their Northern competitors, one would conclude that those in control of Southern mills live in clover the year round, that in order to earn a dividend, all that is necessary is cotton and machinery; that if these two were brought in contact, the dividend would be forthcoming. Possibly these happy results have previously been obtained with slight exertions, but in this year of grace, to obtain satisfactory results, it takes as careful and conscientious watchfulness in Dixie as in New England. Now what are the advantages we hear so much of, and do they exist to the extent claimed for them by many writers? First is the cost of construction and equipment. Brick mills of the best material and all modern conveniences, have been erected at a cost ranging from 40 cents to 50 cents per square foot, and at a total cost of construction and equipment ranging from $17.00 to $20.00 per

spindle, local conditions having been somewhat unfavorable, together with the fact that the machinery cost ten per cent. more than it would in New England. A number of the above mentioned mills were equipped with the latest up-to-date machinery for about $14.25 a spindle, which is higher than the same would have cost at railroad centres in New England. Town taxes in North Carolina and South Carolina average one-half of one per cent; city taxes average three-quarters of one per cent; Georgia and Alabama taxes may by vote, be remitted for a term of ten years. In Arkansas the aggregate taxes cannot exceed two per cent. for town, county, state and school.

COST OF FUEL AND POWER.

Pocohontas coal costs the North Carolina mills $3.25 per ton, while Tennessee coal is delivered at $2.95 per ton. In South Carolina Pocohontas coal cost $3.75 per ton, while Tennessee coal can be secured from $2.80 to $3.20 per ton. Georgia uses Tennessee generally, costing $1.90 to $2.10 per ton. In Alabama coal costs from $1.15 to $1.35 and it is stated one Alabama mill is using local coal which costs from 75 to 90 cents per ton.

The development of water power for cotton manufacturing in the South will not be carried on to any great extent in the future, as steam is proving itself much more reliable and fully as economical. If electricity is to become very much of a factor, then this statement will need to be modified. Southern manufacturers have by experience learned that the actual cost of their water power is only to be arrived at when compared to the relative earning power of a steam plant and a water power plant of equal capacity; and experience has demonstrated that water power is cheaper only under very favorable conditions. A 25,000 spindle mill can be built in the South, we will say for $18.00 per spindle. Its fuel for a 1300 horse power engine will cost $18,000 per annum, which is $13.84 per horse power per year. The most recently built water power mill of that size, constructed at a cost of $25.00 per spindle, required an invest-

ment of $250,000 in developing the water power; this large investment, earned only what it saved, *viz.*: $18,000 or 7 2-10 per cent.

The above described power is that of an unimportant stream fully developed, of which two-thirds of the available power is yet in reserve, this should be taken into consideration. In one other instance the water power is from the development of a large stream and under most favorable conditions. This mill is also of 25,000 spindles, cost $20 per spindle, which includes $100,000 the cost of developing the water power, has a reserve of 11,000 horse power, saves in fuel charges $18,000 annually, thereby earning 18 per cent. on the investment above the cost of a steam plant. In the first instance, local pride demanded the development and erection of a water power and mill; even under adverse conditions. In the latter case, sound common sense prevailed, with the result that a large power has been developed, that can be utilized whenever demanded, and is sufficient for 200,000 spindles. Each of these represent extreme cases, both of cost and results, and are mentioned especially for that reason.

The general opinion is, that the Southern water power is, as has been demonstrated in New England, very much over-rated; and only under the most favorable conditions is it at all to be compared to a modern economical engine and cheap fuel; probably $15.00 per horse power is a safe estimate for the average Southern mill using water power. Steam power will cost from $12.00 to $14.00 per horse power per year, according to favorable or unfavorable conditions.

COST OF MANUFACTURING.

Proportionate elements of cost for	40″ 2.60 *cloth.*
Raw material	61.38%
Labor	15.09%
Fuel and Fixed Charges	13.61%
Commissions, Discounts, etc.	9.92%
	100. %

The following table will indicate the proportionate cost of incidentals, etc.

Fuel cost	18.10%
Supplies	17.11%
Freight charges on finished goods	7.00%
Repairs	9.58%
Salaries	10.34%
Real Estate	2.67%
Insurance and Taxes	4.93%
Interest and Commissions	30.27%
	100. %

These last figures represent the yearly charges of a steam power plant doing a business of $700,000.

AVERAGE WAGES PAID PER DAY IN THE FOUR STATES WHICH COMPETE WITH NEW ENGLAND.

	Georgia.	N. C.	S. C.	Ala.
Picker Hands	75c.	68c.	65c.	60c.
Card "	95c.	80c.	85c.	72c.
Speeder "	90c.	75c.	78c.	80c.
Spinner "	75c.	65c.	56c.	54c.
Spooler "	90c.	78c.	78c.	60c.
Weavers "	100c.	85c.	90c.	90c.
Yard and General Help Hands	70c.	68c.	65c.	60c.

The above table will come very near the average wages in the four States. There are, without doubt, slight variations from the figures given, but not of sufficient extent to alter the general average. The hours of labor vary in the above four states, fully as much as the wages paid.

The best Southern mills on print goods with common looms, will have an advantage of two cents per pound over the New England mills using similar machinery. We frequently read in Southern papers of the South's advantage of cheap cotton, estimated from one-half cent to three-quarters of a cent a pound; these writers fail to remember that a large proportion of the

goods manufactured in the South, are first sent to New England for finishing, and then, possibly returned to New York for distribution, thereby losing the advantage gained on the low price cotton. A mill producing coarse goods will generally use local cottons, and may thereby have this advantage of one-half cent to three-quarters a cent a pound.

But suppose the character of the goods demands a better cotton than is found in the near locality; for instance, if cotton has to be freighted from Arkansas or Tennessee to South Carolina, this advantage would nearly disappear, and if the freight charges on finished goods to New England be added to its cost, the Southern mill is then laboring under a disadvantage. I fail to see any climatic restrictions whatever, of Nos. 40s. and under not being spun and successfully woven in any part of the South, and when the time comes, as it will, for spinning finer numbers I apprehend artificial conditions suitable for such manipulations will be possible; this has been the experience in the East India mills, where the excessive heat of Summer gives way to artificial conditions within the factory. For ten years the South should make but little effort to spin fine as No. 40s., simply because the help will not have had sufficient experience. Meanwhile there will be little need of the South undertaking to spin finer numbers, as there will be no demand for it; but on print cloth numbers the help will, during this time, develop dexterity not excelled by any class of operatives, foreign or native. That the South will in ten years from now produce, with its native operatives, the bulk of seven yard standard print goods there can be no question; when this assertion is denied, we thereby acknowledge that the French-Canadians, Poles, Russian-Jews and Portuguese, who are now being introduced into New England mills, will accomplish more, and have a higher mental make-up, than those who are natives, and are acquainted with our customs and ideas.

CONDITIONS OF MANUFACTURING.

Dog-day weather, so-called, has no terrors for the Southern

spinner even without the use of humidifiers; with their use, however, the help labor with much less fatigue, not so much from better running work, as from being in a more healthful atmosphere; one singular fact is, that we seldom hear of heat prostrations, either from outside or inside labor, this condition I really believe, giving an advantage to the Southern manufacturer not possessed by those in other sections; and is accountable for the continued vitality of our operatives during the severe heated term. We may be asked to explain why it is that so many more hands are required in a Southern mill, than in a New England one? In weaving departments our Southern help will manage successfully as many looms as in any cotton manufacturing country; in spin and card departments, this is not always the case, and is to be expected when one considers the length of time our help have been in the mill; some mills are compelled by circumstances over which they cannot exercise control, to give employment to children of rather tender years. This is the only class of Southern help which are not considered economical, and this is a difficulty which will in time adjust itself; one will always find in Southern cotton mills, a far greater proportion of young persons than will be seen in a New England mill; for instance, on drawing machinery and around cards, boys of fourteen and eighteen years are used, when in Northern mills, help of not less than eighteen years and upward will be found around such machinery. With these few exceptions, hand for hand, we obtain from each operative fully as satisfactory results in the run of a year as is obtained elsewhere.

The following table of 1896 indicates the proportion of persons employed in Massachusetts and North Carolina cotton mills, and will probably represent the South in general, as well as in Massachusetts:

	Mass.	N. C.
Men employed	$43\frac{8}{10}\%$	$29\frac{1}{10}\%$
Women "	$50\frac{6}{10}\%$	45%
Children employed	$5\frac{8}{10}\%$	$25\frac{8}{10}\%$

SOUTHERN OPERATIVES.

One fact which I have noticed repeatedly is, that however countrified a family may be when they first appear for work at the mill, it takes from one-fourth to one-half less time to make good hands of them, than it does to train farm hands of foreign extraction into operatives. This I account for in two ways; however unpolished they may first appear it takes but a short time to discover that their intelligence is as bright as the proverbial new dollar; and as the soil is generally very free of rock a person who has spent years upon the farm, will have a more erect carriage and hands which are but little calloused by farm toil. Those of you who have made operatives from farm hands of foreign extraction, will at once recognize the latter as an evil with which you have had to contend when breaking in a lot of green help. Our New England operatives point to the low wages paid the Southern help as indicating a low order of intelligence. Nothing could be further from the truth. We should remember that these Southern operatives are the children of those men, who for four long years battled for what they thought right; that they lack education in many instances, none will deny; that they are not weak mentally one very soon learns, if he goes among them with any such ideas; they are poor and the cotton factory is to them just what it was to the New England communities 75 years ago, when cotton manufacturing began to be a factor in that section. I am inclined to believe, however, that the lack of interest they indicate in labor laws and labor agitators, is very largely accountable for the New England cry of their not being intelligent; they realize that their present condition is a vast improvement over what it was before cotton mills were introduced; and, unlike the New England foreign operatives they do not look upon the mill officials as enemies, but rather as personal friends this accounts for the kindly feeling existing between the Southern mill officials and their operatives; *while these favorable conditions are maintained, Southern manufacturers have little to fear from their Northern competitors.* We see no cause for questioning the con-

tinued existence of our present supply of operatives, at least not for the next dozen years. That the colored race can ever be made a cotton mill operative, I most emphatically question, and I regard all efforts in that direction, as certain to result in financial disaster to the parties interested. There are advantages which the New England manufacturers now have over competitors, that will ultimately be gained by the latter, *viz.:* his greater experience in the economies of mill construction, equipment and management, his abundant capital, and his ability to secure whatever money he may be called upon to borrow, at two per cent. or three per cent. less interest charges. His nearness to all necessary supplies and repairs, and the comparative low rate of freight charges from the mill to the dyeing, bleaching, printing and finishing establishments, and, at this stage, the ability to dispose of his goods on a commission, often of one-tenth what it cost the Southern manufacturer. I would estimate the present net advantages of white cloth mills in Georgia and Alabama at 30 per cent., divided as follows: ten per cent. for longer hours and new machinery, 20 per cent. for cheaper fuel, lower labor costs, lower taxes and cheaper cotton. I would rate these items as the maximum for mills constructed during the past five years, and not in all of those, for local conditions must always be taken into consideration, and these are as apt to upset our calculations South as elsewhere; for white cloth mills throughout the South which have been constructed over five years, it is doubtful if their present net advantages would reach 20 per cent. There are manufacturers in Georgia who do not admit or either consider that they have any advantage whatever over the New England manufacturer; yet, we never learn of the conditions in Georgia as being considered unfavorable to cotton manufacturing, but rather the reverse.

A GENERAL SUMMARY.

That cotton manufacture of medium and coarse numbers must come South is as certain as fate, and the constant changes West and South of New England's iron, leather and furniture

industries, which have been going on for a dozen years, and from much the same causes as now exists in the cotton industries of New England, would seem to prove the changes natural rather than otherwise. Evidently what this country needs, at present at least, is a complete cessation of all mill building, and an opportunity given for Fall River to recover from its Rip Van Winkle condition. The constant and reiterated statement that the present low price of print goods, is caused wholly by Southern competition, will not bear examination, unless we are prepared to admit that 5,000 Southern print cloth looms, producing 40,000 pieces per week of 28 inches — 64x64 — 7-yard goods govern the price at Fall River of 230,000 pieces similar goods produced on 32,000 looms. It is probably due to the longer hours, and large number of mills on print goods in New England, outside of Massachusetts. The actual danger of Southern competition to Massachusetts mills on print goods, is not yet present but near at hand. For causes of the present general depression, we must look elsewhere and when we compare our annual export of $20,000,000 worth of cotton goods with England's $330,000,000 worth, we can but believe it is our lack of enterprise in not securing a share of these foreign markets; while we now manufacture 90 per cent. of what cotton goods we need, we must not only manufacture the other ten per cent. but get our full share of what the other fellow is doing. This will be brought about as soon as our New England competitors realize the absolute need of a change of methods in disposing of their productions. Those mills in Fall River which paid three per cent. and New Bedford which paid seven per cent. dividends in 1897, are not in danger of being dismantled at present, but rather indicate that mills on fine numbers have no great difficulty in earning a fair dividend. Writers on Southern cotton manufacturing frequently mention our mild winters, and undertake to prove a decided climatic advantage of the South over New England. These writers fail to remember that the heated term of the Southern summer is far longer, and much more severe than that of New England; and, that of necessity,

the operative must have less vitality at its end than those of the cooler climate. I believe that in this respect on account of the severe Northern winters, neither section can at the end of the year show any material advantage whatever so far as climatic conditions have a bearing on cotton manufacturing. Cotton mills of Virginia, Maryland, Pennsylvania, New Jersey and New York work under nearly identical conditions as those existing throughout nearly all of New England. The two former may be considered as Southern mill states in which I am informed wages equal to those of New England are paid, and from which satisfactory dividends are annually secured. The chief difficulty with New England mills is that there is too much paternal legislation and continued efforts to use antiquated machinery; these added to certain exorbitant fixed charges are sufficient in themselves to cause not a little of the present inconveniences through which many of New England's mills are now passing. The present advantages which Southern manufacturers have, the full benefit of which is not always secured, are cheaper mill sites, low taxes, cheaper building material, longer hours, lower wages, cheap fuel, cheap cotton when secured in the local market, aided by a low rate of living expenses and necessities of life; *and what is of as much importance as all the above, freedom from labor agitators.* When the South has thoroughly learned the economies of cotton manufacturing and can finish its own goods, as it should and will eventually, then, and not until then, will the competition be such as to cause uneasiness. At present New England is benefited ten and a half million dollars, which the Southern cotton manufacturers pay for the finishing of their goods, while the railways are recipients of three and one-half millions from the same sources on freight charges to New England, which kept in the South would annually add 600,000 new spindles. For some unaccountable reason, there has previously existed a disposition to value Southern manufactured goods lower than those from other sections; hitherto, this has resulted in a loss to those producing such goods. These values the Southern manufacturer is now refusing, and is de-

manding full values with his competitors and generally is securing what he demands. If the South which produces 60 per cent. of the world's cotton supply, and manufactures only one-twentieth of it, should remain stationary so far as an increase of its manufactures is concerned, it would indicate lack of enterprise in so doing. That there has been, however, a phenomenal increase recently of Southern cotton manufacturing is indicated by the figures below.

Year.	No. Spindles.	No. Looms.	Bales Cotton consumed.
1890	1,712,930	39,231	573,844
1893	2,550,000	54,000	733,701
1894	3,023,000	68,000	723,329
1897	4,105,667	103,298	1,024,482

Invested capital of 1890=$51,124,096; of 1897=$120,000,000.

The PRESIDENT. Very many of our Association will remember that on our journey to Atlanta three years ago to attend the Exposition and hold our semi-annual meeting there, we made a halt at Charlotte, N. C., and as I remarked last night in my paper, the visit that we paid the South at that time was one of those incidents that never would be forgotten by any of those who were so fortunate as to participate. I understand we have with us today Mr. MILLER, who, perhaps, will make a few remarks at this time.

Mr. R. M. MILLER, Jr. Mr. President, I thank the chair for his kindly mention of the entertainment by the Southern Manufacturers' Club of the New England Association on its way to Atlanta. I hope that it will be remembered by them as long as it will be remembered by the members of the former club. I have not yet met Mr. WILBUR, the author of this paper, but I

think he has made a very fair and impartial statement of the conditions that exist in the South today. I think the greatest competition that exists between New England and the South is rather in the newspaper than in the mill. I really do not think there is any competition — any serious competition. The few goods that we make in the South which compete with New England are only a very small percentage, and I cannot see how it could affect the New England mills. On the other hand, I think that we are increasing year by year to finer count, and that will necessitate, possibly, New England's continuing on still finer count, and the paper on mercerization read this morning showed, I think, that New England is calculating on the same thing. I am not very familiar with the cloth mills of the South, as I am only connected with a yarn mill. A few years ago we established a yarn mill in the South, manufacturing 24s to 40s two-ply yarn. We have been very successful in that yarn; we have manufactured as high as some 50s. A neighbor of ours has manufactured as high as 100s. But when it comes to that there is no advantage, as Mr. WILBUR states. We have to go to the extreme South for our cotton, and when that arrives, and local freights are paid, Fall River or New Bedford can deliver the same cotton for the same money, possibly a little less. I do not see that there is anything in the future on the colored labor question. That has recently been tried at Charleston and also at Columbia, and in each case they were complete failures. The majority of us in the South believe that we must still continue to look to white labor in all branches for successful cotton manufacturing in the South.

I do not know that I can add anything more except to say that I heartily agree with Mr. WILBUR in his statements. Being a northern man and seeing for himself in the South, I think he has made a very fair and impartial presentation of the condition.

Mr. STEPHEN N. BOURNE. I would like to inquire what your opinion is about the labor market. Is it so nearly ex-

hausted that there is going to be a scarcity of help, so that you will have to import?

Mr. R. M. MILLER, Jr. Well, in some sections where the mills are going on what they call double time — that is, night and day — we have some little trouble now and then on the night shift. We have had no trouble on the day shift. But mills in larger towns, of 25,000 to 50,000 or 75,000 inhabitants, send to the country, where the mills are smaller, and get their help from the country mill, and the country mill draws its labor then from the farms surrounding. And in North Carolina, I am sorry to say that that labor is almost unlimited. It is an ignorant labor, uneducated labor, and we now have adopted a rule in our state that we will not work operatives under 14 years of age except in cases of extreme necessity. That is, if we hire a family in which there are four good hands and two under 14 years old — say 12 years old — why, rather than lose the family we give those two younger children work. In our mill in Charlotte, the Atherton mill, we make it a rule never to hire an operative under 14 years old except under those conditions. But that country help, that ignorant help, which we call the "poorer white" help in North Carolina, especially in the western, mountainous part of the state, is very large. We feel that we can draw from it for a long time to come.

The PRESIDENT. If there is nothing further to be said we will pass to the topical questions, and the first question is

No. 92. "Where is the economical range that ring filling frames may be used in competition with mules; that is, the lowest and highest number of yarn?"

I do not know where that proposition originated, or whether the originator is present or not.

The SECRETARY. It came over by appointment from the last meeting.

Mr. LOUIS SIMPSON. Mr. President, on that point I would like to say a few words. Some years ago I asked the members if they got the same result from cloth in which was used ring filling as they got from weft filling. Our lamented friend, Mr. KENT, told us that he did. Well, we put in between 8,000 and 10,000 of these frames, and I want to say that I do not. There are some cloths on which I do; there are some cloths on which I get an equal result; some on which I get a better; but on a great many of our cloths I find I cannot use it to advantage. I would imagine, therefore, that this question is bound up very largely by the other question.

The PRESIDENT. I remember very well the discussion to which Mr. SIMPSON alludes, and there was quite considerable said, both pro and con, at that time at that subject, and it was finally dismissed rather indefinitely, I think. I suppose the object of the party who propounded this question was to bring out further discussion and get more light. We shall be glad to hear if any one has any more remarks to make.

Mr. JOHN ECCLES. Mr. President, I think Mr. GULLIVER has had some experience in that direction and I presume he will be glad to give it to the members.

Mr. ARTHUR H. GULLIVER. Mr. President, I believe that the discussion to which you referred occurred after a paper that I read here before in regard to the manufacture of cloths from frame filling yarn. At that time we were spinning, as we are now, 36 yarn on filling frames. I think there is a question, as already raised, about whether the goods finished give satisfaction to the commission house. I think there is where the point is, exactly. There are certain kinds of goods in which you can put frame filling, and they are all right; there are certain other kinds of goods where you cannot do so. We are about to make a change in one of our mills where we are spinning 58 yarn; we are going to put in all frames in place of mules. We have

made quite a number of experiments on the class of goods we are weaving in that mill. In one of our other mills we have woven sample pieces and sent them to the commission house, and they have been unable to pick out which of the goods were woven with the frame filling and which were woven with the cop filling; in fact, they have picked out as the best pieces in one or two instances goods that were made with the frame filling and discarded those that were made with the cop filling as inferior to those goods. Now, I do not say that that is a universal fact; I do not think it maintains in all classes of goods; but I do think that owing to the experience of other mills besides ours, the question of making 58 filling on frames is not a question of experiment. I do not think there is any doubt at all that you can make 58 filling satisfactorily if the goods made with that filling are satisfactory to the parties that are buying them. So far as weaving the yarn is concerned and making good goods, it can be done up to that number and considerably higher, I think up to 120. 120s are spun on the frame, and are making good yarns and are satisfactory in the goods woven. But bringing up that point has to do with another question as to the matter of twist on frame filling, which, I think, is put into the next topical question. I think it comes up this evening. I think the two questions ought to be discussed together, because there is the point where the difficulty lies with the frame filling in a good many cases — the twist that is put into it.

Mr. LOUIS SIMPSON. I would like to ask Mr. GULLIVER if the cloths which he is making are cambrics, and whether they are for bleaching or dyeing. The frame filling would be very suitable for that kind of cloth.

Mr. ARTHUR H. GULLIVER. Well, in regard to that, the goods are bleached goods.

Mr. LOUIS SIMPSON. Bleached goods — yes.

Mr. ARTHUR H. GULLIVER. That, I understand, was the

point here at the other meeting in regard to frame filling — the dyeing *versus* the bleaching. The question was finally left undecided, because certain of the members who had had experience with dyed goods woven with frame filling found it was an experience they did not want to repeat, because the goods did not take the colors in the way they were desired to be put into the goods. But in bleached goods I do not know as that is the case. There is one point in regard to frame filling which I think may have something to do with the settlement of this question, and that is that when the frame filling yarn is put on the bobbin ready for weaving, you can be pretty sure if that yarn is on the bobbin and goes down to your loom, that it is going to be woven into cloth, but you cannot be sure of that on cop filling, because the principle embodied in the old saying that on a mule the twist always runs to the weakest place, has a tendency sometimes to make cop filling, particularly on yarn that is spun from a shorter staple cotton than it ought to be, of such a kind that there is a great deal of waste on the loom, which, of course, decreases the amount of cloth that you can get from a certain number of pounds of cop filling; but on frame filling, after it is once put on the bobbin, there is scarcely any of that that will go into waste.

Mr. LOUIS SIMPSON. For the benefit of our members I would like to add a few words, so that those that may come after me may not get caught as I have been caught lately. I would say that in my opinion, as to whether it is possible to spin frame filling to advantage largely depends on how the cloth is going to be converted and that any mill manager in using frame filling ought to be quite sure that he is not going to put it into cloth that is going to be converted in a way that will not be suitable for it. We were so placed this summer that we were anxious to use all the frame filling we had, and I tried it on different cloths. On some it was first rate; on others it was altogether wrong, not because it would not take the dye, we spin our frame filling very softly twisted, but because I could

not get the right finish on this cloth. I put cloth with ring filling through the finishing department, together with cloth in which the mule filling had been used, both fillings being spun from the same cotton and, in fact, from the same rovings, and every time I was able to pick out which was which, and every time the frame filling did not give me the result wanted, I then went to the trouble and expense of so altering my finish as to meet the requirements, and even then I was not able to succeed. I think as to cambrics I would have no trouble whatever in making the frame filling do, but I just wanted to give the benefit of my experience so that somebody would not get into the same hole that I have gotten into, or if they did they would know what the matter was.

Mr. JOHN ECCLES. I would like to ask Mr. SIMPSON if the twist in the frame filling and the twist in the mule filling were the same, inch for inch?

Mr. LOUIS SIMPSON. Yes.

The PRESIDENT. Are there still further remarks to be made on this subject? If not, we will pass to the next topical question.

No. 94. "What is the best method of treating belts, and their proper care?"

Is any one interested in that question, or are there any remarks to be made? Is that an old question left over?

The SECRETARY. Yes, it was left over by vote. The person whom we expected to discuss it is drawn off by the temptations of the scenery, I think. I trust that he will submit his remarks in writing.

The PRESIDENT. Perhaps we had best pass that question and pass on to the next one.

No. 95. "What is the best method of utilizing the waste products of a mill?"

Mr. JOHN ECCLES. I am very much interested in that, Mr. President. I wish there were some one here who could give us some information with reference to it. We make lots of it in our mill that I think ought to be used. There are, I presume, members belonging to our Association, who no doubt, were they here, could give us some very valuable information. I would like to have that question continued to some other time and not dropped, so as to be taken up again — if not at this meeting, certainly at our spring meeting in Boston.

The PRESIDENT. I presume Mr. BOURNE could give us a little light on that subject at this meeting.

Mr. STEPHEN N. BOURNE. The best way is to use it up — not make any.

Mr. LOUIS SIMPSON. Mr. BOURNE was not born yesterday. He is not going to give away his secrets.

Col. JOSEPH H. KENDRICK. I think I heard our President say once that he once knew a print cloth mill in Fall River where, owing to the dust that he saw and the quality of cotton used, he said, "You ought not to buy this cotton, but buy all waste."

The PRESIDENT. Well, perhaps at Mr. ECCLES' suggestion this may be taken up at another time if there is nothing further to be said now.

Mr. FREDERICK A. FLATHER. Mr. President, what part of the waste does that mean? I do not think I understood that question very well. I looked at it before I came up.

The PRESIDENT. I suppose it includes everything outside of what is put into cloth, if it is a cloth mill. If it is a yarn mill it includes everything except what is sold as yarn.

Mr. FREDERICK A. FLATHER. Well, there are so many

kinds of waste it would be impossible to cover that by any one idea. Any one who has had experience in using up all of the waste it would, perhaps be difficult to find. A great many people are using up their card-room waste. I think that is a very interesting question; I wish it could be analyzed a little and put in different form and brought up at an early meeting.

The SECRETARY. Mr. President, upon the suggestion of the last speaker, I would say that one of our members has had for over a year the matter of a paper on that subject in hand. I know that the paper is not finished and I am not quite sure that it was ever begun, perhaps consideration of the subject by that gentleman may have appalled him. Of course the waste of one generation is a raw material for the next. It is the history of cotton manufacturing in this country that every financial crisis gave developed inventions which used a little more of the waste. It has been going on and going on farther, one of the last elements of saving being the cessation of Mr. BOURNE'S summer stowstorm which came out of the dust flues of his picker chimney and over the surrounding neighborhood until he began to utilize that waste cotton lint which came from the dust room. When I was a young fellow I worked at Rockport, and GILBERT WHITMAN, agent of the Annisquam Mills there, liked to shoot pretty well, and he was quite an ornithologist. The Treasurer of the mill was a man who would squeeze a dollar till the eagle screamed, but had no practical knowledge of cotton manufacturing, and he bought some very cheap cotton very cheap and sent it down there. Mr. WHITMAN told me he was not going to say anything to the Treasurer about it. The Treasurer came down on his monthly visit and he talked and talked on everything from the weather up and down, evidently waiting for Mr. WHITMAN to open the subject, but he finally asked, "Did you get that c-c-cotton I s-s-sent you?" "Yes." "D-d-did you work it all right? Wh-what have you got to say about it?" "Well, can you get some more of it?" "Yes — shade the price, maybe." "Well,

I guess you had better mix a few crows' nests with it." "Crows' nests? What for?" "Oh, it will increase the weight, but it won't hurt the quality a bit." [Laughter.]

Mr. STEPHEN N. BOURNE. That is very true about working the waste down. I have bought a good deal of waste from time to time. A few years ago we had a very good thing in buying comber waste, and that went along and they got on to something and spoiled it. [Laughter.] But we could n't get any claim; they would n't allow it.

The SECRETARY. Mr. President, I would like to ask Mr. BOURNE if one of the smaller mills of Manchester was not really made to work up the waste?

Mr. STEPHEN N. BOURNE. Yes.

The SECRETARY. Was it not the outcome of the financial crisis of 1873? That is to say, the raw material for that mill was up to that time paper stock?

Mr. STEPHEN N. BOURNE. I don't know as it was paper stock, but they used to sell that. They started that mill to use up their waste.

The SECRETARY. They made it into bags?

Mr. STEPHEN N. BOURNE. Yes, and that is all they use today.

Mr. LOUIS SIMPSON. I hardly think it is worth while to keep that topical question on the paper. I do not think any body whose opinion we would think a great deal of is going to tell us the secrets of his trade.

The PRESIDENT. We will pass to the next topical question.

No. 99. "What is the best taper or length of wind for mule cops on No. 37 filling?"

Perhaps Mr. ECCLES will give us his opinion on that question.

Mr. JOHN ECCLES. I do not think, Mr. President, that I can answer that question; we do not spin any filling quite as coarse as No. 37?

The PRESIDENT. Was that question propounded for this meeting?

The SECRETARY. No, that is one that was left over, as were all of the first four questions.

The PRESIDENT. Most of these topical questions on today's programme seem to be questions that have been postponed from other meetings, and the authors or originators of those questions do not seem to be present, so that, really, those questions are of little value, unless some one here sees fit to answer them.

Mr. JOHN ECCLES. Mr. President, I might say that in talking with our friend Mr. COOPER, my attention has been called to what I know is the fact, that where you have a very long taper cop you do not get so much filling on the cop. It needs a very much smaller cop. I should think that a cop with a short bevel or short wind would be fully as desirable as one with a longer paper, and more so when the quantity of yarn on a cop is considered.

The PRESIDENT. That is doubtless the fact down to the point where the cop can be held together.

Mr. JOHN ECCLES. Yes, sir, and not slip off. That depends on the loom more than on the cop.

Mr. JOHN TEMPEST MEATS. I would like to say, Mr. President, that the trouble with this question seems to be that it is too limited. In limiting the number to 37 it makes it practically uninteresting. If it was "What is the best taper for a mule cop?" then you could say that one taper is best where you want to handle the cop a good deal, or that the cops used

should vary according to the purpose for which they are to be used. But that is not clearly germane to the question, because it specifies No. 37 filling.

The PRESIDENT. The inference would be that it is for weaving.

Mr. JOHN TEMPEST MEATS. Yes, in that case you want a taper that is long enough in the early part of the cop to give the cop stability enough to permit the threading of it in the shuttle, and as the cop is built, have the taper shortened so that by the time it is completed you have the full amount of yarn on it; and if at any intermediate point the cop gets snarled in any way the weaver can take it out and clear it and start again. You start with a long wind at the bottom and finish the taper too fast and you cannot do that. There is a point between the two extremes where you can do that and get stability. But in hosiery work, where the question of clearing it is not so often involved, it is invariably the custom to make a long wind on the bottom, so as to give stability to the cop to bear packing and handling, and it will knit off without any trouble in almost every case.

The PRESIDENT. We do not get any very satisfactory answer to that question; in fact, as it is put I do not see how there can be.

That concludes the business that was scheduled for the morning's meeting, and this meeting will be adjourned until eight o'clock tonight.

The meeting then adjourned till 8 P. M.

THIRD SESSION.

WEDNESDAY EVENING, SEPTEMBER 28th, 1898.

The Association met in the parlors of the Crawford House at 8 P. M., President KNIGHT in the chair.

The PRESIDENT. We will listen to a paper by Col. JOSEPH H. KENDRICK of Providence, R. I., on "The Manufacture, Use and Care of Loom Harnesses and Reeds".

Col. JOSEPH H. KENDRICK. Mr. President, ladies and gentlemen, I assure you in the first place that the length of this paper I am about to read bears no comparison whatever to the length of the reader. I say that for your comfort and encouragement. This is the first time, I believe, that the question of the manufacture and use of loom harnesses and reeds has ever been before this Association. As a matter of fact it is a small business, although some large men are engaged in it, and it is decidedly limited in its character. And yet it is an article which is very necessary to the manufacture of goods, and perhaps you may be interested to hear something about it. There are no data on which I could gather or base any statement from anything that I have ever seen or read of. My facts are gathered simply from my personal knowledge of the men who have manufactured, and of the machinery in use for the manufacture of

loom harness. This experience has been one of 50 years, I having entered into the business when I was 16 years old. That is a good while, and yet, like our honored friend the President, I am still a young man.

The PRESIDENT. Thank you.

Col. JOSEPH H. KENDRICK. That was mainly a compliment to the President.

The PRESIDENT. That goes without saying.

Col. JOSEPH H. KENDRICK. I will say that these samples are of extreme length, from the fact that it is the only thing in use today that is knitted by hand. This represents the harness that was made by hand 50 years ago. These were made for the purpose of selvedges, which accounts for their extreme length.

During the reading of the paper the samples referred to by Col. KENDRICK were passed to the audience.

THE MANUFACTURE, USE, AND CARE OF LOOM HARNESSES AND REEDS.

JOSEPH H. KENDRICK, Providence, R. I.

In order to present clearly the different styles of loom harness I have prepared samples, which will be distributed, each kind by itself. Number one is the hand-made harness in general use up to 1846, when the first machine for making loom harness was invented. You will see by this sample that the eye is formed by a double knot at the top with both legs of the heddle on the same side of the shaft. The bottom of the eye is made by loops, which stride the shaft or one leg on each side. The loop side of the harness was often loosened by the drawing-in process when the drawer-in forced the hand between the legs of the heddle and as near the bottom of the eye as possible in order to control the eye of the harness while drawing in. The loop side of the harness formed this way, was always the weak side and would give out when the rest of the harness was good, as when loosened in the loop the harness soon became useless. Up to this date, 1846, little or no improvements had been made in the manufacture of loom harness. About this time a Scotch machine was produced and used to some extent in this country, which made the easy side, so-called, or loop side of the harness, but still left the most difficult or knot side to be made by hand. Also a little later a machine was invented and used in Saccarappa, Me., which made a harness by braiding several threads together leaving the eye in the center, which was kept open during the process of finishing by a wire running from end to end of the harness. This harness had some good points, but after running

for a time the tendency of the eye was to close up and catch the warp yarn and chafe and break it. This harness never came much into use and the main reliance for the production of harness was still by hand. At this time harness was about three cents per bier.

Early in the fifties Mr. JOHN KENDRICK opened a shop in Providence and employed about 60 girls to knit harness by hand. Two kinds of wooden needles were used, one for each side of the harness. Filling these needles with twine by hand was a slow process. At this time a winding machine was brought out for the purpose of filling these needles by power, for which a large price was paid (about $10,000). This machine enabled a girl to wind for thirty hands, which was a great saving and enabled the harness maker to reduce the price of the article about ten per cent.

About 1855 or '60 there appeared a hand-made double knotted harness with knots at both top and bottom of the eye. This harness was intended as an improvement upon the loop harness, then in general use.

This harness was made by Gray & Fish, Worcester, Mass., by Willard Leavens at Danielsonville, Conn., and John Kendrick, Providence, R. I. These harness were on the market for several years and although superior in some ways to the loop harness, the expense of manufacture was too great to allow of their general use and their manufacture was finally abandoned, and the ideal harness was yet to be brought out.

The next that appeared was the so-called double knot harness, and marked number two on sample. This harness has a double knot at each end of the eye and exactly alike. This did away with the loop described in number one and produced a harness just as lasting at the bottom of the eye as at the top. This proved a strong durable harness. The machine for the manufacture of this harness was invented by JOSEPH S. WINSOR of Providence in 1846 and was the first machine in the world to make a complete harness automatically. This machine being patented and the owner not caring to allow others to use his

invention, other makers were forced to find some way to produce a harness that could, if possible, prove as good as the double knot as that was taking the lead in the market.

The next, sample number three, was made on a machine made in England, invented by JOSEPH SLADDIN and called the Bolas machine. SLADDIN later came to Lawrence, Mass., and under the firm name of "Sladdin & Lord," improved the Bolas machine, built several and put them on the market. This machine produced a harness similar to the hand-made loop harness, marked number one, except the top of the eye was made by a single knot instead of a double knot, but the bottom of the eye was still a loop. The bottom legs of the eye strided the shaft, which left it open to the same objection as the hand-made harness in its liability to work loose.

Sample number four is a later improvement which reversed the eye of the harness, putting the loop at the top of the eye and both legs the same side of the shaft, and the knot at the bottom where the legs stride the shaft with less danger of working loose in the loom. The loop being at the top, both legs of the heddle being on the same side of the shaft, the effort is made to fasten the two legs together as far as possible thus to prevent the loops getting loose. When the legs of this loop are perfectly fastened it has much the same effect of a double knot as is intended; but perfection in fastening the loops is somewhat difficult. Some have an idea that knotted harness creates more friction on the yarn but the peculiar construction of the knot is such that no extra chafing is caused and the experience of 50 years has proven that this harness will weave any goods made in the country that any harness will weave, and that it is a strong and durable harness no one will question who is acquainted with the facts. I have no intention to question the value of the different kinds of harness being made. The firm I represent make both kinds and as all patents have expired any harness maker can purchase any and all the different machines in the country. I also will say that the manufacturer was never better served or

got more for the money than he does to-day from the loom harness makers.

When the loop harness machines spoken of in this paper were put upon the market it was claimed that they infringed the patent on the double knot machine, for which the owner, KENDRICK, had paid a large sum. The matter was finally referred to the United States Court, who decided in favor of the plaintiff. This decision made it possible to stop most of the harness machines in the country, but that would have worked a hardship on both the harness maker and the manufacturer. There were also other patents brought into the country from England, which with those already here promised endless litigation and expense. As all harness makers in the country were dependant on the use of some one of the machines for their business, it was mutually agreed to form an organization of all the harness manufacturers for the purpose of buying these patents, which was done and these patents put into the hands of three trustees to be held by them during the life of said patents and during the said term all users of these patents (not owners) paid into the hands of the trustees a royalty on each bier produced, to be paid to the owner of the patents as reasonable compensation for the money they had expended in obtaining their patent rights. This plan was carried into effect and a reasonable price fixed at which all harness should be sold and this action ended what might have proved a long and expensive contest in the courts.

It is not always that an organization of this kind lowers the price of goods produced to the consumer, but it did in this case, for while the harness manufacturer had the power to fix the price on an article the mills must have, they actually made a lower price than had ever been known before, giving a large part of the saving between hand work and machine product to their customers. We are glad to be able to say that in no branch of manufacturing has there been greater improvement than in that of loom harness.

Formerly harness were varnished in the mill by the overseer of weaving and it was a common thing to see a section hand

brushing a harness for an hour or two with tallow before drawing in and nothing was dreaded more by the weaver than a warp with a new harness, but now a weaver would rather see a new harness coming to her loom than an old one and it would be impossible to run looms at the present speed in those days. Harness makers should have the credit of making the present speed possible.

In ordering harness it is important for the maker to know the number of warp yarn to be used, which enables him to better determine what size of twine to use in the harness. It is a common thing for a mill to order harness for fine yarn and not mention the fact that fine yarn is to be used and the harness maker uses a twine suitable for weaving number 30 to 36 yarn, supposing the mill is to weave same cloth as usual while it is possible the mill intends to use number 60 to 70 yarn in the warp. This causes considerable trouble which could be easily avoided. It is also a common thing for mills to order harness ¼ to ½ inch wider than reeds. This makes considerable friction on the selvedges, just where it ought to be easiest, and all harness would give better satisfaction if they were made exactly same spread as the reeds.

In this country the idea prevails that all rooms should be run as cheaply as possible, and in carrying out this view the fact that cheap help is not always the most profitable is lost sight of. Most mills hire a good overseer of weaving and they insist on his running the room with just so many fixers at a stated price, which means that he must hire such fixers as will work at the price named, which does not always command the best workmen. The work runs bad and the cost of supplies increases. I know of some fixers who understand running a loom so well that their sections are always running, the weavers satisfied and the looms turning off the proper amount of cloth with the least possible expense; while in the same room with the fixer who does not understand his business the work runs bad, the weaver complains and the cost of supplies doubles up. He uses double the harness, and twice as many pickers, and all other supplies

in proportion to run a loom. If you examine his loom you will find twice as much power used to drive the shuttle across the loom as is needed, his harness strapped up tight as a drum, his lathe knocking against his harness, and his whiprow too high or too low, which means poor looking cloth and high cost to produce.

In England they give a great deal of attention to the setting of a loom, just the right tension to the harness and never depressing the harness so as to bring the warp against the lathe, but as near to it as possible and not touch, and then the swell in the shuttlebox is just right, not too much tension and the check on the picker-stick is adjusted so as to take off all jar and save extra wear and the pickers. While in this country it is a common thing to see a harness jacked up so tight that it will wear out twice as fast as it ought to, and cause friction on the warp and wear out strapping; then the harness is depressed so low that the warp is brought down onto the lathe, the swell in the shuttlebox so tight that in order to drive the shuttle the picker-stick is made to strike so hard as to often break the picker-stick and to wear out the pickers.

After the expiration of the original patents others took a hand in the manufacture of harness and in order to draw trade from the old makers, prices, already low, were cut still lower and as usual the quality went down with the price. Many of the new and some of the old concerns went down under the pressure of competition and low prices.

About ten years since a loom harness association was formed composed of nearly all the harness makers in the country, the price fixed at which they would dispose of their product. The price was put at 2¼ cents per bier of 40 eyes. This was a low price when it is considered that the twine used is almost entirely made of long staple cotton and combed. On fine work Sea Island is the twine used by most of the harness makers without extra charge. Of this association nearly one-half have been compelled to abandon the business as unprofitable, and those that are left are compelled to give the business their closest

attention in order to get any returns for their investment, as their business is about on the same basis of print cloths at two cents. JOHN KENDRICK of Providence, R. I., T. A. EMMONDS, Lawrence, Mass. and G. W. HARRIS, Lowell, Mass., are the pioneers in the loom harness business, and they or their representatives are still in the business, and their ranks have been increased by others who have learned the business thoroughly; but scores have in the last fifty years attempted the manufacture of loom harnesses who knew little or nothing of the business and have utterly failed and disappeared. The changes in the style of doing business today where the mills make a great variety of goods, and taking orders today to be filled in a very short time, demand that the harness maker shall be prepared to fill his orders with the least possible delay and compels him to keep twice the amount of machinery on hand that he averages in use. The larger makers today are called upon to supply harness in from five to ten days and must be prepared to knit from five hundred to one thousand shades a day that as little time as possible shall ensue between the knitting machine and finishing.

I would impress upon manufacturers the importance of giving from four to six weeks, if possible, for the making of their harness. Where this is done a more satisfactory job can be provided and this rule can be observed on standard goods. While a harness can be made in three or five days that will last a while on easy weaving, a longer time should be given when possible.

The question is often asked what rule a reed maker has for spreading the dents for a certain sley and to produce certain widths of cloth. It will be safe to allow seven per cent. for shrinkage in weaving, but it is impossible to give a rule that will work the same in all cases, but for an illustration: Suppose we want to manufacture 40 inch, 80 sley goods that calls for 3,200 ends and to bring the goods 40 inches from loom we will add seven per cent. to the width of the cloth and set the reed 1600 dents on 42 $\frac{80}{100}$. This is as near as the reed maker can come and under proper conditions will give the desired results,

but the weighting of the warp or adjusting the temples and beating in the filling may vary the width of the goods and it will be found that in the same mill on different looms in the same reed the width of the cloth may vary a half inch or more, but for this variation the reed maker cannot be held responsible.

The manufacture of reeds is a trade that few have learned. There are some who try to see how cheap a reed can be made regardless of work produced. There is no objection to buying a good reed cheap if you can (?) but a poorly made reed will be dear at any price. Many reeds are being sold today at a price that makes it impossible that they should be anything but inferior. It is not easy for the manufacturer to determine whether the wire for the reed has been properly prepared or not. One-half the labor may be withheld from the rolling and finishing and the buyer perhaps not know the difference, but the yarn will know the difference, and the chafing in the loom will cost more than the higher price paid for a better article. A lighter wire may also be used, which makes a narrow dent where a wide one is needed and is worth more than the difference in cost. There are no two things more important in the mill than a reed and harness, and the cost of the best is so small that the amount can hardly be figured in a piece of goods. The difference between the highest price and the lowest on these articles is next to nothing on a loom per year, but the difference in results may amount to much.

In the care of reeds and harness little need be said. Not much will be gained in revarnishing harness during their use unless it is done after each warp or two and it is doubtful if that will pay. When harness are to be laid away and not used for a time they should be kept in a room with moderate temperature and no grease or other substance put on them. Reeds are often spoiled by being kept either open or in boxes in a damp place where steam or moisture can reach them. The keeping in a dry place is the only protection they need.

In closing I would say the dates mentioned in connection with patents and improvements may not be absolutely correct,

but are substantially so, the intent being to trace as nearly as possible the changes in the making of loom harness for the last fifty years, which have resulted in giving to the manufacturer goods in this line well nigh perfect, and at a price about 33 per cent. less than could be bought before these improvements were made.

Mr. President, if you will allow me a word, I will say through you to the gentlemen present that if there are any questions that they wish to ask in regard to these matters about which I can give them any information, I shall be very glad to answer any question that may be of use to any manufacturer. There are no secrets about our trade that we are not willing to tell — how we do a thing and why we do it.

The PRESIDENT. I am sure, gentlemen, that the harness and the reed as used in our manufactures is a very important element in the manufacture of cotton goods. I think that I am correct when I say that this is the first time during the whole existence of this Association that the question of reeds and harness has been brought up. I may be mistaken about that, but I have that impression. Our Secretary tells me that for three years or more he has been endeavoring to have the subject of reeds brought before the Association for discussion, but for some reason he has failed in doing so. I am sure that Col. KENDRICK'S paper will be highly appreciated by us all, and I could wish that if there were any questions that would give the members any light or information, they would put those questions to Col. KENDRICK, because I know, as he has said to you, that he is not only able but willing to answer them. The matter is in good hands, and perhaps we never shall have an opportunity to learn the true facts of the matter better than we should through

the present channel, and if any members feel disposed to ask any questions or make any remarks, there is an opportunity for them to do so now.

Col. JOSEPH H. KENDRICK. Mr. President, I have been asked a great many times why 20 heddles or 20 dents are called a bier — sometimes spelt *beer* and sometimes *bier* — usually *bier*. I have never found any explanation of it in any of the dictionaries that I have ever seen. It was brought here, of course, from the old country. My impressions are that it is very properly spelt *bier*, from the fact that most reed and harness makers, so far as I know — I have known a great many of them — when they get ready to go to the cemetery are either carried there by their friends on a bier or else they walk. They do not usually get money enough ahead so that they can afford to ride when that time comes.

The PRESIDENT. We will now listen to a paper on "Cotton Grading and Mixing," by ARTHUR WHITTAM of Orangeburg, S. C.

COTTON GRADING AND MIXING.

ARTHUR WHITTAM, Orangeburg, S. C.

The grading and mixing of cotton is one of the departments in a cotton manufacturing plant to which very little attention is paid by some mills, and as the quality of the yarn produced depends to a very large extent upon the amount of systematic care and attention given to this most important branch of the industry, it is then plainly evident that skillfully grading and systematically mixing are an absolute necessity in all progressive manufacturing establishments.

When the planter brings his cotton to the market it is graded by a class of skillful experts, the cotton buyers as they are generally termed, who, although they may be entirely ignorant of the treatment to which the material is subjected in the subsequent manufacturing processes, have from long familiarity with the subject acquired a certain empirical knowledge of the conditions of value and preparation in which the different kinds of cotton are brought into the market and it is certainly surprising that valuations even when performed by different buyers so often agree in substance.

There are, however, several defects in the present system of grading, which to one who has to convert this same cotton into finished goods, very naturally strike him as matters of great importance, upon seeing the buyer pass upon samples and attach their grade without taking sufficiently into consideration such counterbalancing qualities as cut, nepped, twisted or curled fibre, etc. Many of these defects are attributable to careless and improper ginning whilst others are due to the natural con-

dition of its growth; and any single one obviously lessens the value of the fibre to the manufacturer.

Taking these things into consideration, and allowing for the difficulty experienced in fixing the price with precision, there are other considerations which serve to show that a difference in price does not always insure a corresponding difference in the workable quality of the cotton. Two samples of cotton valued at the same price may be very widely different in actual value, as for instance, a good color may work up for a defect in length of staple, or the value of an originally fine fibre may be reduced by an admixture of crushed and broken seed, so that the samples valued alike may be very unequally adapted to the same purpose.

In some mills, and especially Northern ones, a large amount of attention is paid to these matters when purchasing cotton; and this is to a certain extent, one of the many reasons why the output of Northern mills commands as a rule prices somewhat better than those obtained for Southern manufactured goods.

In buying cotton two important considerations should always be kept prominently in view, namely: the quality of goods to be produced and the necessary grade or grades required to produce the same.

These matters carefully and intelligently adhered to; we then consider what is the best and most profitable system of mixing.

But before going further into this subject let us for a moment look into the custom practiced by a great many mills in the South of buying any cotton that is offered them for sale, provided, of course, the price is consistent with its grade; never taking into consideration the grade of goods into which it is destined to be manufactured, apparently absolutely ignoring the fact that after carding, proper " mixing " or blending and careful selection of the raw material is the *sine qua non* of the yarn producing departments.

Of course a great many of these mills are on coarse work and the lowest grades of upland cotton can be utilized for their products to advantage if proper care and attention is paid to the

adjustment of the machines in the different stages of the manufacturing processes. This being the case, then why buy better cotton than is really necessary? And a great many mills in the South are to-day paying not less than one-half cent per pound more than is absolutely necessary for the class of goods they turn out.

Another custom the defects of which are obvious is that of storing away the cotton indiscriminately and without the slightest regard to its grade, instead of placing all bales of like grade together and leaving them easy of access, so that when required for mixing they may be brought out for every mixing in such lots as will secure the same blend until the cotton on hand is all consumed; thus maintaining uniformity in the quality of the resultant products of the mill.

It is customary in nearly all European mills to make a test of each purchase of cotton in order to find the average loss sustained the year around. In doing this a small amount of cotton is taken from several bales of each grade, or the different grades may be tested separately; these samples are then placed together and generally amount to from 200 to 400 pounds altogether. By taking a large amount a better average of the percentage of impurities contained in the cotton is obtained. Then after weighing carefully, the cotton is passed through the various machines in the picker room and later through the carding engine, a record being kept of the weight of every lap or can of sliver after coming out of each machine. In this way the actual, visible and invisible losses can be obtained and where each individual grade is tested separately it enables the manufacturer to judge more intelligently on the number of bales of each grade to put into the mixing in order to secure the most economical results.

In addition to this, every bale before using should be tested by the superintendent or some person thoroughly competent to judge on these matters, both as to the length, strength, regularity and maturity of the staple, and any bale not coming up to

the standard of its respective grade should be put to one side and rejected, or mixed with several bales of superior grade.

Now in reference to the methods of mixing as practiced by some mills. I should like to mention the fact that some Southern mills, and especially small ones, do not put down any mixing at all; but simply take the cotton directly from the bale and place it into the automatic feeder, and in one particular case I saw a bale of cotton being used which would be graded as Strict Good Middling, whilst the very next bale to be opened was of a much poorer grade and would certainly not have passed for better than Low Middling. With this system practiced or that of merely opening four or five bales and dumping them on the picker room floor in such a manner as to not even suggest a mixing, one cannot expect to convert the raw material into good or even fair yarns.

It is frequently that the space that can be utilized for mixing is entirely inadequate, especially in the mills of old construction, and even in some more modern buildings the space intended for this department is certainly not large enough for a proper and systematic mixing to be laid.

Such being the case, however, it only remains to utilize whatever is at our disposal to the best possible advantage, and in doing so I would suggest as the best system to adopt the following, which, although of long standing, has been proven by experience to be the best.

First: Decide on the number of bales of each grade you intend to put down, assort them proportionately and take, say a third of a bale from one grade, shake loosely, or if a bale breaker is used, place it on the lattice a small layer at a time and after passing through the breaker rolls, spread over the allotted space for mixing; then take a like amount from a bale of another grade and spread on top of layer number one, and so on until a part has been taken from a bale of each grade intended to be mixed, after which begin again on the first bale opened taking about one-half of what remains, and repeat until the first lot of bales have been mixed. Then open another lot

and lay it down in the same way, always taking care to avoid if possible having two bales of like grade placed together. Whenever only one grade of cotton is used it is advisable to put down only about a third of a bale at one time before changing to another bale, as in many cases there is quite a variation in the quality of cotton packed in a single bale, and the smaller the individual layers, the more uniform is the quality of the yarn obtained therefrom.

The mixing should then be allowed to stand as long as is practicable prior to being used; this enables the cotton to open and spread more uniformly and at the same time it absorbs moisture from the atmosphere, which is most essential to good spinning.

This system of allowing a mixing to remain unused for some time necessitates, of course, two mixings of like grade to be kept, for as soon as one runs out it should be replaced immediately, this should also be allowed to stand until required for use.

Where a new mixing is made from entirely different grades of cotton, a second test is sometimes made by taking a vertical section of several hundred pounds of cotton from the mixing or sufficient to enable its being carried through the various machines and a thorough test of the yarns produced therefrom made; this is then compared with the standard of the goods you wish to maintain, as it enables you to judge more intelligently whether or not it would be advisable to make any changes in any particular machines, of the preparatory processes. It is always advisable to keep a sample of yarn showing the standard of quality desired, since it frequently happens that over several weeks or months the quality of the yarn may be very materially reduced; and while the difference in quality between the yarns produced in any two periods next each other may be so small as to be practically unobservable, yet the deterioration from the standard sample would be strikingly great.

In conclusion, I would say that a short time ago I had a Southern mill superintendent tell me there was no necessity for

putting down large mixtures nowadays as recent improvements in cotton picking and carding machinery were so marked as to insure a first-class yarn in nearly every respect, even if the cotton was delivered directly from the bale to the automatic feeder.

His views, of course, did not coincide with mine, and I can safely say from experience that without a proper system of mixing — strictly adhered to — which will enable us to secure a thorough blending of the various qualities, and the elimination as far as possible of the inequalities present in different bales, or in various parts of some bale, we cannot expect to obtain yarns uniform in quality, color and elasticity, even in strength, or to secure at the outset an economical production.

The PRESIDENT. This subject is now open for debate, but before it is entered upon I wish to state that tomorrow evening we shall have a paper by the Hon. WILLIAM C. LOVERING of Taunton, and his paper relates to the modern bale, or to what I believe to be the coming bale — the new bale, which will bring about such an entire revolution of the baling system that the present method of mixing cotton will, in my opinion, be entirely annihilated, and perhaps we could discuss that question more intelligently after we hear Mr. LOVERING'S paper. The method which Mr. LOVERING proposes to show us is somewhat different from anything that we have as yet seen. However, the subject is open for discussion, and if anyone has anything to say on the matter there is liberty for him to do so.

Mr. JOSEPH M. DUNHAM. The experience I have had in handling cotton has taught me that the most necessary point is as to the length of the cotton. You certainly cannot mix long cotton and short cotton and spin it without combing and make

good threads or yarns, and it seems to me that that is about the only point I know. Some cotton is finer than others, some has a stronger staple than others, some is dirtier than others; but the main point, in order to get an even yarn, is to work cotton of the same length — not take cotton that is ⅞ inch long and mix it with cotton that is 1¼ inches long. I never would think of making cotton batting if I had a lot of cotton without opening a large lot and taking from every bale right straight along, or take a bale and have a bin of a certain size and scatter that bale all over the bottom, and then take another and scatter over that. and so on until the bin is full, and then when you begin to take the cotton, go down through it from top to bottom, then you have a pretty good mixture.

SLASHER CYLINDER BEARINGS.

FREDERICK A. FLATHER, Lowell, Mass.

You are all familiar with the truck bearings that are usually employed for supporting slasher cylinders, and, therefore, will be interested in the Lowell Machine Shop's new Roller Bearing for this purpose which Mr. WALTER E. PARKER, agent of the Pacific Mills, mentioned at our last meeting during the discussion of Mr. TRYON'S admirable paper on slashers. Mr. PARKER at that time mentioned some of the points of excellence contained in the Lowell Machine Shop's new slasher, and continuing, stated that probably all of you knew that cylinder bearings wore considerably and gave considerable trouble on that account; that the Lowell Machine Shop was fitting up Roller Bearings to run in cylinder oil or oil that would stand the heat of the steam, and that he thought they would be a great improvement. A general view of the bearing is shown on page 199.

Mr. PARKER had bearings of this type furnished upon a slasher which the Lowell Machine Shop made for the Pacific Mills and they have now been running some time with good satisfaction. The cuts marked Fig. 2, Fig. 3 and Fig. 4 show partly in section, an end elevation, a plan and a side elevation, respectively.

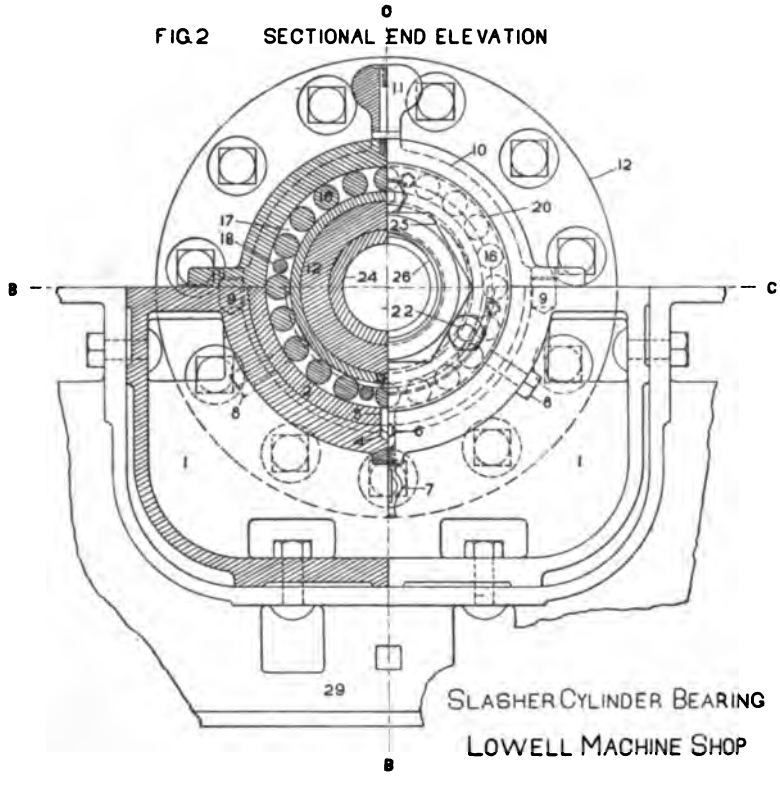
PARTS OF LOWELL MACHINE SHOP'S ROLLER BEARINGS FOR SHASHER CYLINDERS.

1 Main Bearing Casting.
2 Hardened Steel Lining for Bearings.
3, 3 Oil Reservoirs.
4 Channel Connecting Reservoirs.
5 Oil Hole in Hardened Steel Lining.
6 Plug for Cleaning out Channel.
7 Drain Cock.
8, 8, 8, 8 Screws Holding Hardened Box Lining.
9 Pins to Hold Cover in Place.
10 Cover to Keep Out Dust.
11 Knob.
12, 12 Journal.
13 Hardened Steel Sleeve pressed on to Journal.
14 Pin, Preventing movement upon the Journal of Hardened Steel Sleeve.
15 Oil Drip Collar.
16, 16, 16 Hardened Steel Rollers.
17 Bronze Cage Rings for Hardened Steel Rollers.
18 Stay Pins or Studs for Bronze Cage Rings.
19 Stuffing Box.
20 Gland.
21 Packing.
22 Gland Screws.
23 Threads on Stuffing Box, Cut Right or Left Hand.
24 Connection for Pipe Elbow.

The general shape and dimensions of the truck bearing were retained when designing the Roller Bearing for purposes of interchangeability, but changes in the details were made for the purpose of obtaining hardened rubbing surfaces, which are essential for the permanency of roller bearings. For the journals such hardened surfaces were obtained by covering them with hardened steel sleeves, made of .40 per cent. carbon steel tubing tempered in oil, ground perfectly smooth, straight, true and to the proper diameter, upon their own journals.

Under the old form of construction the stuffing boxes were

FIG. 2 SECTIONAL END ELEVATION

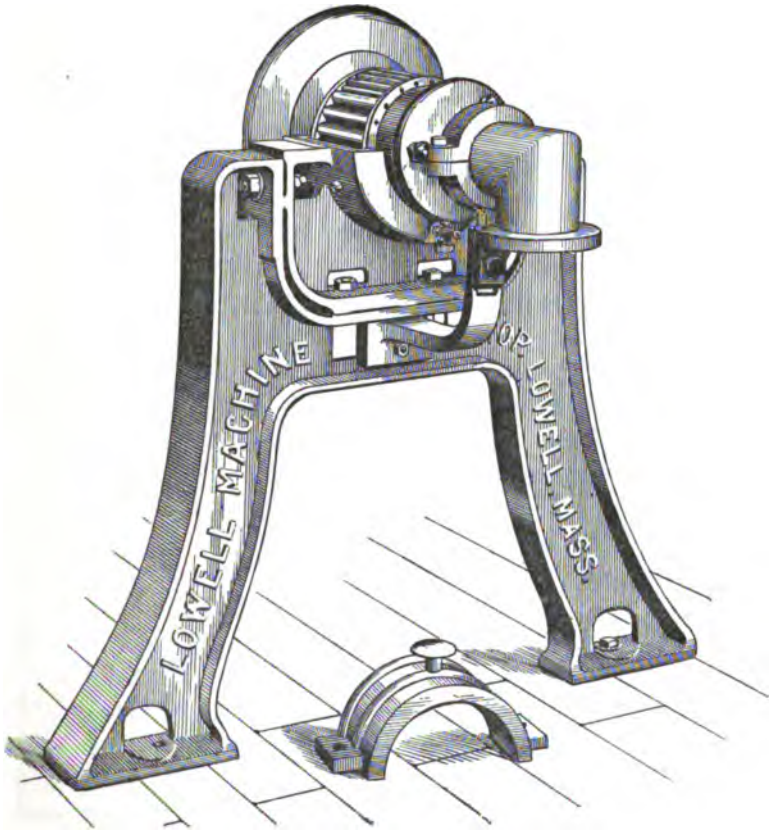


SLASHER CYLINDER BEARING
LOWELL MACHINE SHOP

integral with the journal. In order to put the steel sleeve upon the journal the stuffing boxes had to be removable. This was accomplished by threading them on to the journals by screw-threads cut right-hand for one end of the cylinders and left-hand for the other end, so that the friction between the stuffing boxes and elbows when the cylinders were revolving would not tend to unscrew them. The 20 steel rollers 21-32 inch diameter and 4 1-16 inches long which surround and some of which support the journal are hardened and ground with the same care as the sleeves. Their ends fit loosely in pockets bored into bronze rings. Four double-ended studs lying parallel to and among the rollers are riveted into the rings and complete the cage. Their shoulders hold the bronze rings just far enough apart to allow the rollers a little end play and maintain an axial alignment of the rollers and journal. The bronze cage-rings are made smaller in their outside diameter than the bore of the bearing, and larger in their inside diameter than the diameter of the journal, to prevent their rubbing hard against either the bearings or the journals.

The bearings in which the steel rollers run have and need no cap bearings but they are covered for purposes of cleanliness. They are lined with hardened steel made of tubing split longitudinally and these linings after being fastened into place by four cap screws tapped in from the under side are carefully ground to dimension.

To provide for lubrication, flanges at each end of the bearings project upwards from the main bearing castings until only a clearance is left between them and the collars on each end of the journals. These flanges clear the steel linings endways about one-half inch and dam the ends of the oil reservoirs. The height of these flanges is such that the level of the oil in the reservoirs can be sufficiently high to submerge the lower half of each roller, as it reaches the lowest place in its path of rotation. There is a channel for oil in the main castings, just beneath the steel linings, connecting the oil spaces in the ends of each bearing. Taps in the outer ends of the main bearing

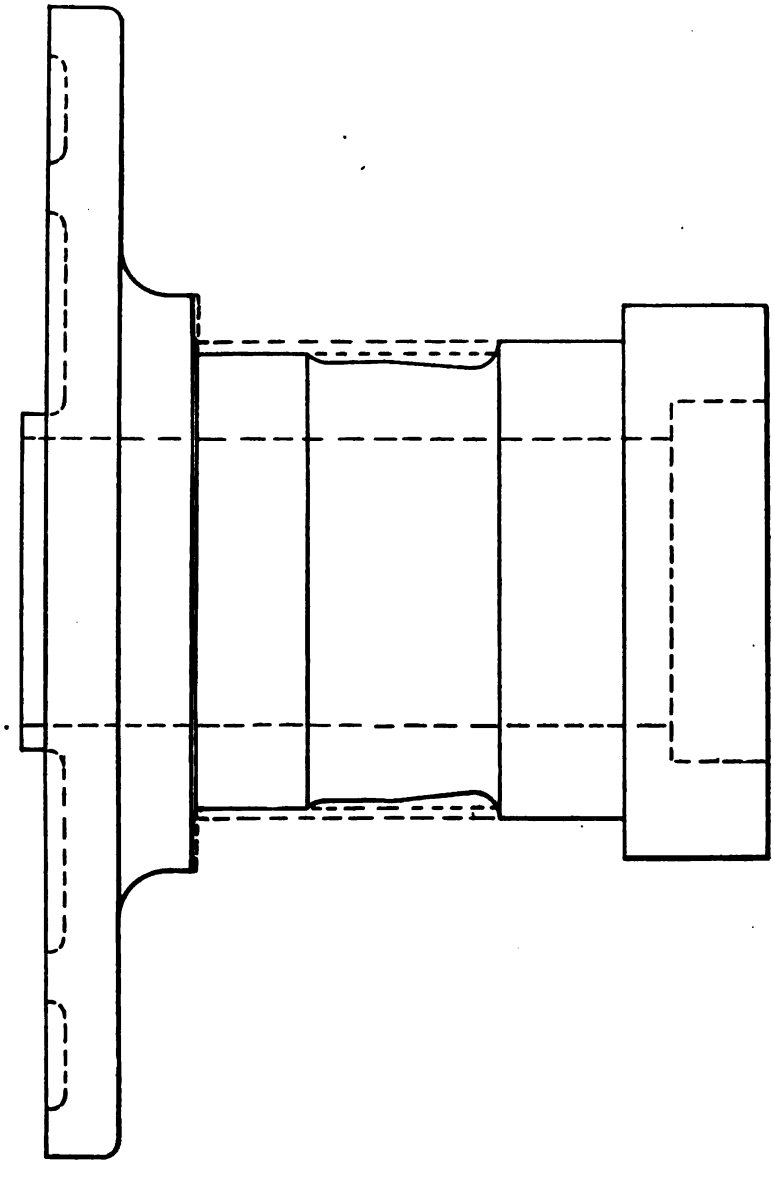

LOWELL MACHINE CO. LOWELL, MASS.

castings provide convenient places for draining and cleaning out the reservoirs.

The old style truck bearings had trunks which were shorter than the journals. They have always cut into the journals and have been made in various ways; sometimes with one truck about eight inches diameter, directly below the journal and a horn on each side of the journal projecting upwards from the main casting to take the side thrust, but with the running parts uncovered and exposed to dust and dirt at the end nearest the cylinder, sometimes with side trucks in place of the horns; and best of all, until the present improvement was made, two trucks with the journal resting upon both wholly covered for purposes of cleanliness. The difficulty with all such bearings is that sooner or later the trucks fail to revolve and the journals become cut. When this occurs the cylinders start hard and require more power, and if the warp is tender or contains only a small number of ends, considerable piecing has to be done. If the bearings on one end of the cylinder only are cut, thereby lowering the worn end a little, the warp strains towards one side, and to avoid piecing the operative starts the slasher carefully and slowly, thus wasting his time and lessening the production.

Journals have frequently been cut to a depth varying from one-quarter to one-eighth inch and if the piping is rigid, the interior surface of the journal drops down upon the elbow and creates excessive friction. The stuffing-box, when the journal lowers itself by cutting becomes eccentric to the elbow, and the packing which revolves with the journal is soon cut enough to allow steam to escape on the under side. Fig. 1 shows the journal of a truck bearing after it has become worn, the dotted lines showing the original form.

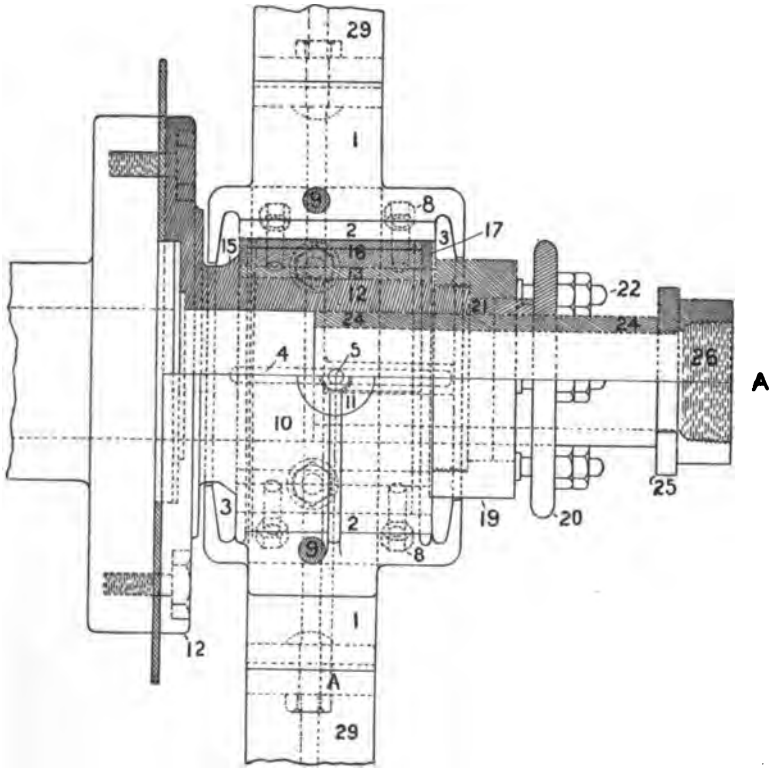
FIG. 1



A careful test was made to find out how much more drag was required to start a cylinder with truck bearings than with Roller Bearings, and the table herewith shows the results. Under the best conditions possible the truck bearing required over five pounds to start the cylinder, and, as it is found in most mills that one, two, three or four trucks refuse to revolve, tests were made to show the additional drag that their stoppage created. Under the worst condition more than 19 pounds were required to start the cylinder. How much more drag is caused by the elbow rubbing against the interior surface of the journal when it is lowered by cutting, I will leave for your imagination.

The roller bearing eliminates considerable of the friction found between the bearing and journal in slasher cylinder bearings, but it has developed in running these bearings that further work is necessary in order to have the cylinders run lightly. The steam piping when being fitted to the slasher is, of course, made of the proper length, but when steam is turned on it expands considerably. This crowds the elbow, or whatever connection is used, against the interior of the journal. The elbows fit the journals tightly, and a very slight expansion can make a great deal of trouble. The Pacific Mills having noticed this difficulty are experimenting with a flexible connection made of a short length of rubber pipe. The results are quite satisfactory but are not yet beyond the experimental stage. There is a very good arrangement used on paper machinery for connecting steam pipes with revolving cylinders, and it might work well on a slasher. It has a ball joint which gives a slight angular movement, requires no packing, does not leak, and lasts a long time. It adds practically nothing to the friction in the journal, as it is free to move more than expansion in the steam pipes would require. There is a ball joint steam connection for passenger cars upon the market which might work well on slashers. Some have been sent for and they will be given a trial. If anything is accomplished in this direction the Lowell Machine Shop will be glad to give manufacturers the benefit of their experience.

FIG 3
SECTION C.-C.



TESTS MADE OF SEVEN-FOOT SLASHER CYLINDERS TO DETERMINE THE NUMBER OF POUNDS OF PULL UNDER VARIOUS CONDITIONS THAT IS REQUIRED AT THE PERIPHERY OF THE CYLINDER AND IN A LINE TANGENT TO IT TO START IT WHEN IT IS AT A STATE OF REST.

The first tests numbered from one to five inclusive were conducted with the cylinder supported upon truck bearings, *i. e.*, the journal at each end of the cylinder rested upon two trucks in the usual manner.

The sixth and last test was conducted with the cylinder fitted with the Roller Bearings which this paper is intended to bring again to your notice.

The elbows were removed from the stuffing-boxes and there was no friction upon the cylinders excepting at the bearings.

Test No.		Pull required to start cylinder.
1	with all four trucks revolving freely,	5.42 lbs.
2	" one truck prevented from revolving,	10.12 "
3	" two " " " "	12.96 "
4	" three " " " "	15.93 "
5	" four " " " "	19.14 "
6	" ROLLER BEARINGS,	.68 "

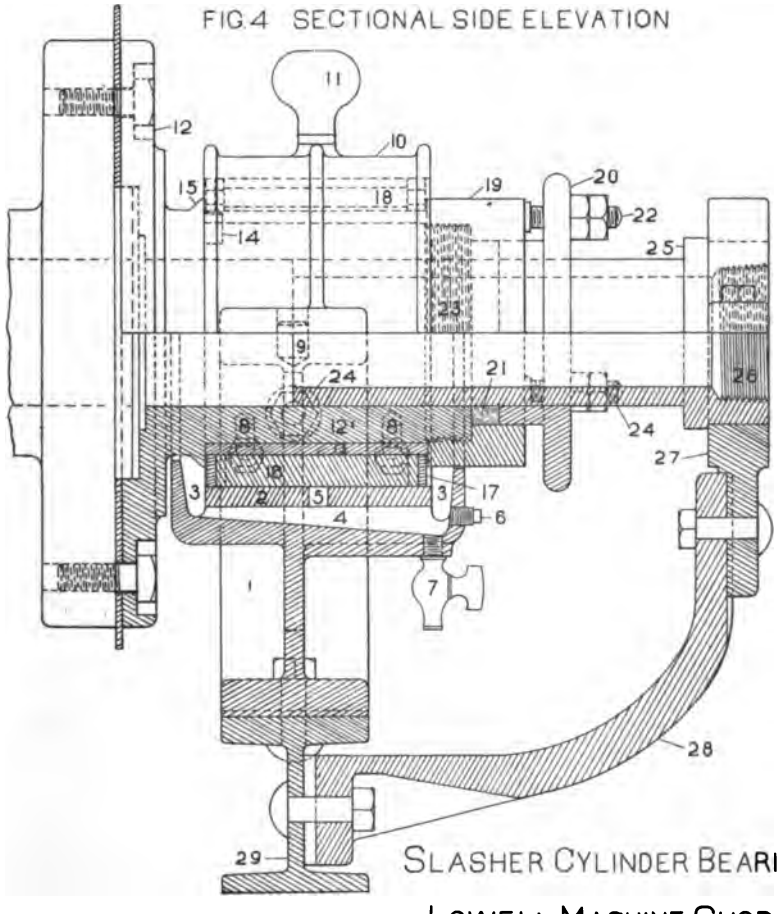
Lowell Machine Shop,
Lowell, Mass., September 9, 1898.

The Roller Bearing which is practically exempt from wear requires less than three-fourths of a pound, showing itself greatly superior to the truck bearing which requires 5, 19 or more pounds.

The Roller Bearing need never run hard. The ease with which the steel sleeves, rolls, and bushings can be replaced in case they should ever wear or meet with accident, insures the user against all future trouble. When a truck bearing which is made of soft cast iron wears it is found that all the adjoining parts are also worn and an entire renewal is the only way of repairing the damage.

Managers have not always realized the extent of the financial

FIG.4 SECTIONAL SIDE ELEVATION



SLASHER CYLINDER BEARING

LOWELL MACHINE SHOP

loss due to the lessened production, and waste of labor and power which results when the trucks stick because they have become clogged with dirt or worn. Consequently, they have sometimes neglected to replace such defective bearings when the interests of their companies would have been better served if they had replaced them. Of course, such loss is small when compared with the total loss which would occur if a similar neglect should extend to all parts of the entire plant.

The PRESIDENT. Any questions that may be asked Mr. FLATHER I presume he stands ready to answer.

If there is nothing to be said on that subject we will take up the topical questions, in part, at least. The first is

No. 100. "Can ring frames be successfully employed as a substitute for twisters on fine numbers."

The PRESIDENT. I have not at hand the name of the party who gave us that question. If he should be in the hall I would be glad if he would open the discussion; or has any other gentlemen any other remarks to make in regard to it?

Mr. THOMAS G. COX. Mr. President, could not Mr. WELCH enlighten us on that subject?

The PRESIDENT. Mr. WILLIAM WELCH of Hopedale.

Mr. WILLIAM WELCH. I am not a member of your Association, Mr. President, and hence I do not care to say anything on the topic.

Mr. JOSEPH M. DUNHAM. On reading this question I could not make out what the man who asked it was trying to get at.

"Can ring frames be successfully employed in fine doubling?" That is to make a twister of a ring frame, I suppose.

The PRESIDENT. I think that the meaning of that, as near as we could ascertain, was whether common ring frames could be used as a substitute for twisters on fine numbers profitably.

Mr. JOSEPH M. DUNHAM. I should think we could tell that better after it had been tested.

The PRESIDENT. I suppose the idea was that it had been tested, and I am quite sure that it is in practice by some mills today, but how successfully I do not know. I know there are mills twisting yarn on common ring frames in lieu of twisters. Parties that have been making cotton goods and have switched their mills off on yarn temporarily and wished to avoid putting in twisters, are using part of their ring frames for twisting purposes.

Mr. LOUIS SIMPSON. Mr. President, if they are doing that I should think they would have a very poor product. I do not think you could ever make a ring frame do the work of a doubler.

Col. JOSEPH H. KENDRICK. Mr. President, as Mr. WILLIAM WELCH is not a member of this organization, I move that he be invited to address the Association on that point.

The motion was seconded and carried.

The PRESIDENT. Will Mr. WELCH give us the benefit of his knowledge or experience, if any? Knowledge I know he has, but experience I do not know about.

Mr. WILLIAM WELCH. My long friend over there [Col. JOSEPH H. KENDRICK] likes to hear from a short one. Put us both together and we would make two men of average size, side by side. I would say, Mr. President, that Mr. SIMPSON has

hit it about right. You can do it on dry twisting, I should say, with fair success, but on wet twisting I doubt very much whether it could be done without a considerable outlay; and when you go to spending money on a ring frame and making it over into a twister you are making a very expensive machine and then not getting as good a quality of product as you would from a twister built for that purpose. I know many mills where they have turned their ring spinning into dry twisting the last year or two and are having fair success, but they get more knots and not so good quality of work.

Mr. JOSEPH M. DUNHAM. I guess it would not stand a great deal of pulling, would it?

Mr. STEPHEN A. KNIGHT. I might say in regard to that matter that I had learned of some mills that had changed their ring frames into twisters as a substitute for twisters, and that I, myself, in changing one of our mills from a cotton cloth mill to a yarn mill, had thought it best to look into the matter of twisting on frames from the fact that I had more spindles than I could supply carding for and make satisfactory yarn; and what investigation I have made and what facts I have learned are certainly against twisting on ring frames. I have learned that it is very difficult to get a uniform twist on account of the weight of the bobbin and the great draft from the roll to the bobbin in order to get the twist sufficiently laid; that the power is one very great objection. There is not power enough in the band to drive the spindle when the bobbin becomes loaded with the friction necessary to put on the traveler, so that in very many instances they get quite a large amount of slack twisted yarn. I did not propose this question, but inasmuch as I was personally interested I thought that if there were any facts about it that I did not know I should be very glad to learn them. My own opinion would be that it would not be practical to get a good quality of twisted yarn on ring frames.

Mr. CHARLES H. RICHARDSON. Mr. President, what does

Mr. WELCH mean by "fair success"? It must be that the frame will either do it as well as the twister, or that it will not do it as well as the twister. If it will do it as well as the twister, then he gets fair success; if it does not do it as well as the twister, then he does not get fair success. Now there is another long man asking you a question. [Laughter.]

The PRESIDENT. Will Mr. WELCH please to answer the big man, who is not so long, perhaps, as the other? [Laughter.]

Mr. WILLIAM WELCH. The President could probably answer the question better than I could. Then again, I am one of the men that have access to nearly all the mills in the country, and I am not supposed to tell any one what the other fellow is doing. If I did, I should not have the hearty welcome that I get from most of the mill agents and superintendents and mill owners in this country. I have no right to come here and tell why a thing did not work satisfactorily in any mill which I have visited. I think Mr. KNIGHT has covered it.

Mr. CHARLES H. RICHARDSON. He says he cannot do it with fair success.

Mr. WILLIAM WELCH. You can do almost anything you want to.

Mr. CHARLES H. RICHARDSON. Not with fair success.

Mr. WILLIAM WELCH. You can change your ring frame into a twister, but you cannot make a ring twister without a good deal of outlay. You have got to doff oftener, and that means more knots. You do not get the even twist that you do with the twister.

Mr. CHARLES H. RICHARDSON. You cannot hatch chickens with a wheelbarrow so well as you can with a hen. You cannot have fair success with it, because you cannot do it.

Mr. WILLIAM WELCH. Mr. RICHARDSON, I beg pardon; our friend Mr. KNIGHT is doing it. I had a twister of this kind in a mill where I was overseer so many years in Woonsocket, when I worked for the brother of our President, and we got along and had fair success; but I could have gone through it better and had fewer knots if I had had a twister made especially for it.

Mr. CHARLES H. RICHARDSON. Mr. President, that is exactly what I wanted to get, because there are so many of our Association who when they hear Mr. WELCH say that it can be done with fair success are bound to try it. I want to show by his own statement that it is not practicable. It can be done, but it cannot be done with any degree of success that is commercially valuable.

Mr. STEPHEN A. KNIGHT. I think I can answer the question of Mr. RICHARDSON by relating a little experience in my younger days. Some of you, perhaps many of you, will remember DAVID WHITMAN, who many years ago was a mill constructor. It was my good fortune to fall into the hands of Mr. WHITMAN in the early days of his mill construction. We put in some machinery that was imported, and it was very unsatisfactory in its operation. Mr. WHITMAN, for some reason or other, took a little notice of me and asked me to work with him and see if we could bring that machine to perfection. We made various changes, many of them for the better, and improved slowly upon it until he suggested a change that I should make in his absence, which, he thought, would finally remedy the whole trouble. Mr. WHITMAN went away and I made the change. In a week or ten days he came to the mill and said, "Have you got that mule so that it works all right"? "Well," I said, "I think, Mr. WHITMAN, it is about right." He said, "Never say that word again; there is no such word in the English Dictionary; there is no such word that is accompanied with common sense. It is either right or it is wrong. When you say it is about right, that

means that it is not right; therefore it is wrong." Now there is only just one of two things; it is either right or it is wrong, and I think what Mr. RICHARDSON intends to say is that this yarn twisted on a ring frame is not twisted as well as it is twisted on a twister, then it is not a success.

Mr. LOUIS SIMPSON. Hear, Hear!

Mr. CHARLES H. FISH. Mr. President, I do not consider that Mr. WELCH needs any particular backing up on this question, but it strikes me that it depends altogether on what you are doing with this twisted yarn. In the mill where I am situated, we are at the present time and have been for over a year, twisting with ring frames a great deal of yarn for our own use in weaving. The yarn is not twisted as well as you could twist it on a modern twister. It does not look as well, and it costs a little more. It goes, however, into a certain grade of goods which we print and finish, and I would not give a fraction of a cent to have that yarn twisted any better than it is on the ring frame. Now if we were to run continuously — if we intended to run continuously or were sure of running continuously that grade of twisted yarn — it would without any doubt be of advantage to us to put in twisters. The original outlay would be considerable, and in view of the fact that the market is rather uncertain it seems better to get along with the ring frame twisting. I should say that in that particular case we were meeting with fair success. I should not say that we were twisting with absolute success, because if I should bring the yarn here and you should look at it, you might criticise it and say that it was not well twisted. It would not do to sell for hosiery purposes, neither would it be called a nicely twisted yarn, but it is good enough for the low grade of cloth that it is going into, and it strikes me that when you use the phrase "fair success," it depends a good deal on circumstances; depends upon what your standard is, whether or not your phrase is allowable.

Mr. THOMAS MAYOR. I think a ring frame is made to spin

yarn, and when you come to put two hard threads together it is about impossible for that ring frame to produce a twisted yarn that would be satisfactory for sale. You may use it in your own mill and make it go. The ring frame is for one purpose and the twister is for another, and my experience tells me that there is a great deal that can be done on the ring frame when properly handled by good judgment that cannot be done when you are pressing two hard threads together.

Mr. CHARLES H. FISH. You understand that the ring frame when used as a twister is not taken in its original form; you have to make some changes; and whether or not it is a success — that is, whether you can say that you can successfully twist yarn on a ring frame — is dependent entirely on the results, and if you can go ahead and rig up your spinning frame and twist your yarns cheaper than you can go into the market and buy them, and, perhaps, as we did in the case of this particular grade of goods, dispose of all that we could possibly make, I should say that it was "fairly successful," to be allowed to use the old phrase.

Mr. THOMAS MAYOR. That is very true, but I consider that only a make-shift way of doing things.

Mr. CHARLES H. FISH. Yes, sir, it is a make-shift way, and the question is then whether or not it is not better to make a "make-shift" than it is to go to the expense of buying twisters to run through one season and then try to get the Drapers to take them back again. [Laughter.] I am very sure they would not take them back, if I hear correctly a side remark by Mr. DRAPER.

The PRESIDENT. The next question is

No. 101. "How much more than standard twist is it necessary to use in spinning frame filling to make satisfactory yarn, and make its use economical?"

That partakes a little of the nature of one of the questions that we have previously considered — of spinning filling on frames or mules. However, this is a question from which, perhaps, there may be some information gained. If any one has any remark to make in regard to that, we shall be very glad to hear from him. Mr. ADAMS, can you give us any light on the subject?

Mr. ALFRED E. ADAMS. I do not think my experience in spinning filling on ring frames would be of any value in this direction.

Mr. THOMAS MAYOR. Well, I will say this: I think it depends on the judgment of those who are running the frame. If you compel a person to put on a ⅞ bobbin with a ¾ diameter ring, he cannot govern that unless he puts on a good deal of twist; but you bring that ¾ ring to a ⅝, then you can regulate the twist so that it will be almost as soft as with a mule, and that is as near as you can possible go.

Mr. LOUIS SIMPSON. Mr. President, I think it depends a good deal on the quality of the cotton you are using and also on the size of the bobbin you are using even more than on the size of the ring. I think it is a pity that this topical question had not been asked rather more definitely, because there are so many uncertain elements about it that I do not think we are hardly able to discuss it.

Mr. CHARLES H. RICHARDSON. Mr. President, I suppose the idea of that question is, how much more than standard twist have you got to put in if you spin your filling on a ring frame? I do not suppose if you are going to spin fine filling that you would use a very heavy bobbin or a particularly large ring. I have spun considerable filling on a ring frame. My first business in the mill was mule spinning. I ran a mule room for several years, and became very much attached to that method of spinning yarn. I thought it was the only way to spin filling,

but for several years past I have used ring frames for filling and have learned, very much to my disgust you might say, that I could spin filling on frames just as well, and with just as little twist, as I did on mules. Now, that might be doubted, but there are several mules that I know of that are spinning filling with standard twist on ring frames, and spinning it successfully— not fairly successfully, but successfully. [Laughter.] That is, they are doing it cheaper than they can in any other way, and are doing it just as well.

Mr. THOMAS MAYOR. I believe that from experience, and it certainly can be done.

The PRESIDENT. I imagine the meaning of the question was how much more twist, if any, it would be necessary to put into a ring frame in order to make it successful than on a mule with the same quality of stock and preparation — of the same roving, in other words. It is the relative difference between the two.

Mr. ARTHUR H. GULLIVER. We have had this point up before at the meetings of the Association, in regard to coarser numbers of filling, and it has usually been considered that, taking No. 36, which as the standard number, we are putting in from ¾ to 1¾ more turns of twist to that number of yarn on the frame than we are on the mule. I suppose one question is — and I am sorry Mr. ADAMS did not say more about it — that we are running the roll faster than we originally intended to on the frame, and in order to have it successful at that speed as it leaves the roll, we are putting in a little more twist. It seems to me that the point we want to determine, and the one that came up this morning, is when we put the filling frame up to 60 and 80, whether we can spin the yarn that will be satisfactory in the cloth and not be obliged to put in more twist than the standard mule filling. Mr. RICHARDSON has answered that question partly, certainly on that point, but the idea is that it is quite an important thing sometimes in determining the cost of making filling on a frame to know how

much or how little twist it will be wise to put in more than the standard twist.

Mr. THOMAS MAYOR. What diameter of ring is it?

Mr. ARTHUR H. GULLIVER. In regard to that, I think none of us are going to spin filling unless we have the right ring, because it is too costly to put in a ring that is either too large or too small.

Mr. THOMAS MAYOR. Is it too costly to make the bobbins a little larger?

Mr. ARTHUR H. GULLIVER. No, but it does not seem to me we are going to neglect either of those questions in putting in a filling frame; but the point is, supposing we make these the best that we can, is it then even possible to spin 80 filling or 70 filling with the same twist exactly as we are putting in on the mules?

Mr. THOMAS MAYOR. If you would put in a larger diameter bobbin your girls would be able to mind two sides more and give you a greater production with as good work as the mule.

Mr. ALFRED E. ADAMS. Mr. President, I am not prepared to discuss this question, I have not looked it up but I will make this statement as to what I am now doing. I am spinning No. 45 filling with less than 21 turns of twist, and it is being done at a speed of about 148 turns of the front roll on a 1⅜ inch ring. I do not know as that pertains to this question; it simply shows what is being done on that number. I think the twist is very near the standard; that is, if we make any allowance for the loss in twist. We are using 1 3-16 inch staple cotton.

Mr. CHARLES H. RICHARDSON. Did I understand you that you were spinning No. 45?

Mr. ALFRED E. ADAMS. Yes, sir.

Mr. CHARLES H. RICHARDSON. Well, I suppose 3¼ would be considered the standard twist, wouldn't it? In this case that would bring No 45 yarn to 21.80. I understand Mr. ADAMS that he is running at 21 or less.

Mr. ALFRED E. ADAMS. Yes, 21. I do not remember exactly what it is.

Mr. CHARLES H. RICHARDSON. That would be less than the standard twist.

Mr. STEPHEN A. KNIGHT. I should infer, then, from Mr. ADAMS' remarks that he could spin filling on frame properly arranged with as little twist as is required, or at least down to the standard or less. I so understand that, Mr. ADAMS.

Mr. ALFRED E. ADAMS. I have been spinning No. 45 filling under the present conditions for something over two years and on quite a number of frames.

Mr. D. EDWIN IRVING. Mr. President, I would like to ask Mr. ADAMS if the cost of frame spinning and mule spinning is different in filling?

Mr. ALFRED E. ADAMS. I could not state that just now.

Mr. STEPHEN A. KNIGHT. I think it is pretty generally understood that we can spin filling on a filling frame, if it is spun at all, for less money than we can on a mule.

Mr. D. EDWIN IRVING. Yes, sir; I wanted to know how much that difference was.

Mr. STEPHEN A. KNIGHT. Just how much that difference would be I have not had experience enough to determine.

We will leave the two remaining topical questions to be taken up tomorrow morning, as our time has expired, the hour having arrived when the orchestra is expected to return.

Adjourned to Thursday morning at nine o'clock.

FOURTH SESSION.

THURSDAY, SEPTEMBER 29, 1898.

The Association met in the parlors of the Crawford House at 9 A. M., President KNIGHT in the chair.

The PRESIDENT. Gentlemen, our first subject for this morning is the topical question,

No. 102. "With modern picking machinery properly managed, revolving top flat cards and three processes drawing slubber and speeders; what are the finest numbers yarn one can with advantage spin before introducing intermediates; stock good middling one inch staple?"

I do not know whether the propounder of that question is with us or not. Is there anything to be said on that subject? If not we will pass to the next topical question,

No. 103. "In what respects are ropes an advantage over belts for main driving?"

Mr. FRANK H. UNDERWOOD. For purpose of discussion, the question of "In what respects are ropes an advantage over belts for main driving?" is briefly answered by arranging the points of advantage as follows:

1st. Cost of installation is less, particularly where distance between centers is great, for the reason that while cost of pulleys and sheaves to transmit same power is about equal, the cost of

ropes, compared with belting is much less. Hence, the greater the distance between center of shafting, the less the cost of rope transmission compared with that of belting.

2nd. The same power can be transmitted in much less width of space with rope than with belting. For instance, where a 24-inch double belt traveling 3800 feet per minute will transmit 350 H. P. with 125 pounds strain per lineal inch in width, five 1¾ inch ropes with the American system of transmission will transmit the same power occupying a width of space of only 14 inches. Hence where the space for engine or pulleys is limited the rope system is preferable.

3rd. By means of the automatic tightener as used in the American system of rope transmission, the ropes are always kept at a proper tension to transmit the power desired and when part of or the whole of the load is thrown off the tension carriage moves back and relieves the strain on the ropes and bearings, while with belting the belt has to be tightened sufficiently to transmit the maximum power and when the load is thrown off there still remains the same tension on both belt and bearings, and there is a useless expenditure of energy to overcome the friction.

4th. Rope can be used where distance between centers of shafting is short, where belting could not be used at all or where it would give constant trouble if used. In the Ameriean system of rope transmission the constant factor of tension is in the weight carried in the tension carriage or tightener, and it is always present whether distance between centers is long or short, while with belting the constant factor of tension is in the weight of the belt itself and this factor is present in a less degree as the distance between centers of shafting grows less, until it reaches a point where it is not practicable to use belting at all.

5th. Where the drive is vertical or nearly so, the American system of rope transmission can be used to greater advantage than belting for the reason that the rope itself is of lighter weight than belting and does not have as great a tendency to fall away from the lower sheave as does belting from a pulley, and further,

the contact of the rope with the lower sheave is kept constant by the means of the automatic tightening carriage, which controls the slack and keeps the rope in practically as close contact with the lower sheave as if the rope was running in a horizontal position. Also in the vertical position the rope can be used to convey power from a common driver to two or more lines of shafting situated on floors above or below the driver, by means of dropping off one or more ropes on each floor, and thus combine in one drive the numerous belt drives which it would be necessary to use if belting was employed as a transmitter of the power required.

6th. For drives where the load or power transmitted is uneven, the rope is particularly well fitted by reason of its elasticity, the rope giving under sudden loads and thus taking the shock off from engine or main pulleys, and here again the automatic tightener plays an important part in taking care of the slack which a sudden increase of power throws into it, the tightener setting back to its usual position when the normal load is reached.

7th. The noiselessness of rope transmission as compared with belting. In many positions it is essential that as little noise as possible be made by the transmitter of power. Here the rope plays an important part. Owing to the uneven surface of leather belting there are numerous air pockets formed between the surface of the belt and the pulley, thereby detracting from the transmitting property of the belt, and at the same time there is a noise made by the air being expelled from between belt and pulley at first point of contact, and at the same time the noise is further increased by the hammering of the hard surface of the leather belt against the iron face of pulley. In the rope transmission these noises are entirely absent, as owing to the soft nature of the rope its contact with the iron sheave is noiseless.

In conclusion we must say, after considering the various qualifications of rope for main driving, that it is, in almost all cases, much to be preferred to belting for main driving, and that it has none of the faults found in leather belting.

The PRESIDENT. Are there any remarks in regard to rope driving? If parties have facts to give us that will be of interest to the members we shall be very glad to have them.

Mr. STEPHEN N. BOURNE. Have any of the gentlemen had any experience with rope driving?

The PRESIDENT. How is it about Mr. BOURNE? Has he had any experience in that direction?

Mr. STEPHEN N. BOURNE. I have not had any experience with it, except in a small way years ago.

The PRESIDENT. I think rope driving in a large way is almost the exception as yet; there are not many who are conversant with it. I was hoping there might be someone present who was familiar with it. Mr. SIMPSON [the gentlemen named having just entered the room] we have just read a communication from Mr. UNDERWOOD in regard to rope driving. Could you give us any information in regard to that?

Mr. LOUIS SIMPSON. Well, Mr. President, I have not had very much experience in regard to rope driving. In England all the mills I had to do with were driven by gears. In Canada I have had some experience with what is called the Dodge system. I regret that I can not say that I care much for it. I know that in several of the English mills the English system does very well; but it is one of those things that unless the grooves of the pulleys and the ropes are properly made, will give a great deal of trouble. At our own place, where we had to drive otherwise than by motors, we use the belt, and I think that for a country mill, where you are away from shops, it makes the safer drive of the two.

The PRESIDENT. My own experience with the rope drive has been very limited, and with the exception of points that were at angles with our main driving power, the experience that

I have had with it has not been very favorable. There are instances where we want to carry the power to points where it would not be practical to carry belts, where the power is run from the main driving wheel out of doors to another building and in some instances turning corners or half corners, where we could carry power through a rope cheaper and more easily than by belts. Aside from that I have not had experience enough to give a very correct idea of the value of rope driving.

Mr. STEPHEN N. BOURNE. Do you understand the system which Mr. UNDERWOOD describes is substantially the same as the Dodge system?

The SECRETARY. It is the Dodge system which was invented by the late WALLACE H. DODGE. Mr. FRANK H. UNDERWOOD of this Association is the resident New England manager of the Dodge Manufacturing Company, who has also sent this descriptive book for the library of the Association. [Exhibiting book to the members.]

DIFFERENT VALUES OF COTTON MILLS.

WILLIAM F. SHERMAN, Boston, Mass.

In these days of close margins or no margins in cotton manufacturing it has become quite a common thing for mill owners and managers to seek reductions in assessed valuations for taxation, and questions frequently asked of mill engineers by manufacturers, and even in the court room, show that a clear understanding of the different values of a cotton mill is by no means universal. Any one who supposes there is but one value for a cotton mill will soon discover, by giving a little study to the problem, that it is not so.

Let us in a very brief and pointed way see if we cannot shed some light on this subject and *all* understand what now seems confined to a comparative few. Let us start with the first cost of a new plant. This is very easily arrived at by any one who is actively engaged in building mills. To the cost of the building, including foundations, is added the machine shop prices for all of the machinery, plus freight where it is not included by the shop, getting into the mill, placing and leveling. Then expense of shafting, belting, piping, furniture, apparatus, tools, supplies and starting up. An easy, straight-forward problem into which the element of depreciation, from use or age, does not enter. This may be called a stockholder's or owner's valuation of a new plant. Not so easy is a careful valuation for underwriters' or insurance purposes.

Intelligent insurance on manufacturing property should be arranged in conformity with the methods adopted to ascertain the amount to be paid after a total loss by fire has occurred.

Too many cases in past years have been arranged without sufficient care, leaving the close and careful computation to follow the loss.

Now an underwriter's computation of values has nothing whatever to do with original costs of the plant, unless perchance such original values *happen* to agree with the conditions at the time of computation, which seldom occurs.

Neither has an underwriter's computation anything to do with the relation of the buildings to the machinery, that is whether the buildings are well designed and arranged or otherwise for the work to be done in them, whether a well balanced or poorly balanced plant all through, and of course land and foundations are never included.

In the standard forms of policies adopted by most states it is stipulated that "All losses shall be estimated according to the true and actual value at the time the same shall happen" and this is taken by our leading underwriters to mean the cost of *replacing* the property with a credit for a just and fair amount for depreciation for the use already had of it and this without regard to what the property may have cost five, ten or twenty years before or whether a building after modern methods could be made to cover the machinery for less or more than one like that burned. The matter of depreciation from use and age is one not so easily arrived at by everyone, and yet the writer of this paper in making a specialty for eight years of this line of estimates for the factory mutual companies was many times surprised at the unanimity of opinions on the average life of machinery, card clothing, belting, etc., etc., gathered from machine builders and users.

The late WILLIAM B. WHITING, whom you all knew so well, had an unusual talent for seeing through and collecting such data, and he laid a large foundation for careful and complete valuations during his many years of active duties in connection with factories of various kinds. A part of those years it was his sworn duty, as secretary of a large factory insurance company, not to participate in any insurance that exceeded in total three-fourths of what would be necessary to replace the property.

In later years when blanket policies became fashionable and underwriters wanted the premiums that came from insuring 90 per cent. of a fair value, there came an increased necessity for close figuring and some of us younger men supplemented Mr. WHITING'S work with extensive observations as to the natural life of many kinds of machinery under fair treatment, as well as collected many opinions from extensive and observing machine builders, so that today there are many practices or uses of depreciation figures under given conditions that have become almost rules for such cases.

Now as to valuations for taxation. Assessors' duties are defined in most state statutes to be to assess property according to its true cash value on the first day of May. A broad expression is it not, about which honest men of good business judgment may differ. The best definition of "True cash value" is, we think, the following: "Such a sum as a party having the requisite capital and desiring to buy is willing to pay for the plant, the owner being willing but not forced to sell." It is to be admitted that even this is a matter of judgment, but it will be claimed that engineers who are working frequently on such valuations and keeping posted on actual sales as they occur will approximate very closely to a fair valuation. The fact that some Assessors may not be sufficiently expert in such matters to arrive at correct results does not change the principle any, and the fact that Assessors have strayed away from correct figures, in times of depressed business, has led to the many hearings in recent years for the purpose of changing their figures. Such a valuation as is outlined above may vary very widely from an insurance valuation or from the first cost of constructing the property, since the saleable value must depend very largely upon its earning capacity in able hands, while insurance valuation has *nothing* to do directly with earning capacity or its market value. A large block of manufacturing property was sold in Rhode Island after standing idle for several years for a small sum of money. It was at once insured by the new owners for a much larger sum than it was purchased for, and justly so. In

another case a mill was totally destroyed by fire when selling prices of machinery and building materials were rapidly falling. The loss was paid in accordance with values the day of the fire. By waiting a little the owners replaced the property and saved a handsome part of their insurance money. The underwriters were criticised strongly for paying more money than the new mill cost, but they could do no differently any more than they would be justified in waiting on a rising market and paying the bills on completion of the new mill.

Several cases have happened where mill managers have kept what might be termed a stockholder's account of cost, *i. e.*, adding to the first cost of the mill extraordinary repairs or extensions, such as replacing an old form of roof with a new modern one, and called such figures the value of the mills for insurance, which was manifestly wrong. One case comes to mind where insurance was placed by such figures for $200,000 more than would replace the property until discovered by an engineer's estimate and corrected.

In the many pieces of manufacturing property taken by the Metropolitan Water Board of Boston in the valley of the south branch of the Nashua River the consideration paid did, in some cases I am told, come quite near to the amount of insurance carried, but only happened to coincide, while in other cases it was quite different. Recent hearings in taxation cases have developed greatly varying conditions. Some mills well cared for and kept up, old machinery being replaced with all modern improvements of real worth, show up as worth more as money earners than some new mills poorly handled with no standing in the market, and hence the saleable or market price is large and no reduction in taxation was obtained. While other mills that cost a high figure originally but have been allowed to run behind and become poor money earners are valued very low.

I will not weary you further by discussing at length valuations for rentals, or for hiring of money or for bonding property, for I trust none of you are making cloth in a rented mill, and of course none of you ever have occasion to hire any money.

THE POSSIBILITIES OF A NEW METHOD FOR DRYING TEXTILE FABRICS.

CHARLES H. FISH, Dover, N. H.

In presenting for your consideration a discussion of the theories of drying cloths or other substances with and without the assistance of a vacuum, and in comparing the theoretical results with figures obtained as the result of a more or less incomplete series of tests of a vacuum drying apparatus, I must confess that I feel I may be putting myself in somewhat the same position as the man, who, starting for a drive steps into his carriage, takes up the reins and then finds that the horse is still hitched to a substantial post, and that there is nothing for him to do but to get out and begin over again, regretting that the start was made so hastily, and trusting that those who were in the immediate vicinity at the time would be kind enough to forget all the details.

The theory of drying or evaporating by the aid of the vacuum is however so well defined, and a careful study of this theory presents to us such immense possibilities, that the subject cannot but be one of considerable interest to those who have occasion to dry quantities of fabrics or other materials.

The drying of wet substances by bringing them in contact with steam heated plates involves the following principles. The rate of flow of heat through a plate from one side to the other varies with the nature of the substance of which the plate is composed, is proportional to the difference in the temperatures of the two sides, and to the area of the plate, and is inversely as the thickness of the place. These relations may be expressed

by the formula $H = \frac{Atk}{c}(T_1^0 - T_2^0)$, in which H equals the amoun of heat, or number of heat units, flowing through a plate of the area A and thicknesses c, in the time t, one side of the plate being maintained at the temperature T_1^0 and the other at T_2^0; and k is a coefficient the value of which varies with the nature of the material of which the plate is composed. k is defined as the amount of heat flowing through a plate of unit area and unit thickness in a unit of time, the two surfaces of the plate being maintained at a units difference in temperature.

This formula of course assumes that the surfaces of the plate are clean and bright and that the plate itself is composed of a perfectly uniform substance. In practice it is found, that, owing to their being dull and corroded, there is a further resistance to the passage of heat, met at the two surfaces. As a plate has necessarily two surfaces regardless of its thickness, what we may call the surface resistance is the same for different thicknesses of plates. If the nature of these surfaces is such that this resistance is large, it may be seen that the thickness of the plate, and even its material may become unimportant factors. Experiments show that this is often the case.

The important and practically the controlling factor, is the difference in temperature between the two sides of the plate, the inside and outside. As the inside temperature is dependent entirely upon the temperature of the steam, which in the case of dry cans as usually constructed, can be varied only within a limited range and then without great economy, we naturally look to the outside surface, which can be and is to a greater or less extent, constantly cooled in the process of drying. The more rapid the circulation of the material being dried, the more the temperature is reduced and therefore the greater the difference in temperature between the two surfaces. So it is apparent that in striving to get the best results we should obtain as nearly as possible the above condition.

It having been shown that the amount of heat transmitted through a plate is proportional to the difference in the temper-

atures of the two sides, it is obvious that to dry a certain piece of cloth on a certain heating surface, it will take twice the time, where the difference in temperature between the two sides is only ten degrees, as where the difference is 20 degrees. For example let us take the case of a set of dry cans which use low pressure steam. We will assume five pounds by gauge to be the average pressure of the steam within the cans, and we will consider it to be saturated steam. The temperature of the inside surface of the cans will then be that due to the pressure, or about 227 degrees Fahrenheit. As the water in the cloth is being evaporated at atmospheric pressure, the temperature of the outside of the cans will be 212 degrees for all cans where evaporation is taking place. Our difference in temperature which is the head under which the heat is flowing through the plate, is 227 degrees — 212 degrees = 15 degrees. If by any means we can double this difference in temperature or this head of heat, we will be able to either dry twice as much cloth on the same cans, in the same time, or we may dispense with half the cans without decreasing the capacity of the set.

In accomplishing this increase of head we can of course increase the temperature inside the can, which involves a higher pressure, or we may lower the boiling point of the water in the cloth by lowering the atmospheric pressure about the cans.

The principal objections to raising the pressure of the steam, assuming that the cans are of unlimited strength, are, first that it is expensive, and second that it is inefficient as compared with the other method.

In mills, print works and bleacheries where large amounts of cloth are dried there is always a considerable amount of power used, and as a rule it is found to be of advantage to utilize the steam for generating the power before it is used for heating and drying.

Probably the most successful method is to exhaust steam from all the engines of the plant, into a low pressure system of piping in which a pressure of about ten pounds gauge is maintained, and to take the steam required for drying, from this system.

In this way a considerable amount of low pressure steam is had at a reasonable cost. The actual cost of the steam per pound may readily be calculated for any case, where the data is at hand. To illustrate this, let us take a factory which uses 1,000 H. P. for power, and which requires for drying and other purposes 30,000 pounds of low pressure steam per hour. For the sake of simplicity we will assume that the 1,000 H. P. is developed in one engine. We will adopt a high pressure engine exhausting into a low pressure system at ten pounds back pressure. We must exhaust into this system 30,000 pounds of steam per hour, and it only remains to adopt an initial steam pressure which will enable our engine under these conditions to develop 1,000 H. P. We next must find what it would cost to develop this 1,000 H. P. with the most modern compound or triple expansion condensing engines running under favorable conditions. This cost would include interest on the investment, proper charges for fuel, depreciation, taxes, repairs, supplies, attendance, etc. Against this figure set the corresponding figures for our original simple plant, running with the ten pounds back pressure. The difference in the yearly cost of operating the original plant and that of the assumed plant will give us the annual cost of the low pressure steam, and from this we can obtain the cost per pound.

In most instances it will be found that the cost of the low pressure steam obtained in this way will be so much lower than the cost of high pressure steam, that the use of the latter will not be feasible.

Then again, the value of steam at ten pounds gauge, as a heating or drying agent is but little less than that of steam at 100 pounds. Referring to our steam tables we find that the total heat of saturated steam at ten pounds gauge is 1154.9 B. T. U. The total heat of steam at 100 pounds gauge is 1184.9 B. T. U. Assuming that the drips leave the dry cans at atmospheric pressure there will be carried away by condensed steam 180.8 B. T. U. per pound of steam. There is available $1184.9 - 180.8 = 1004.1$ B. T. U. per pound of 100 pound pressure steam and

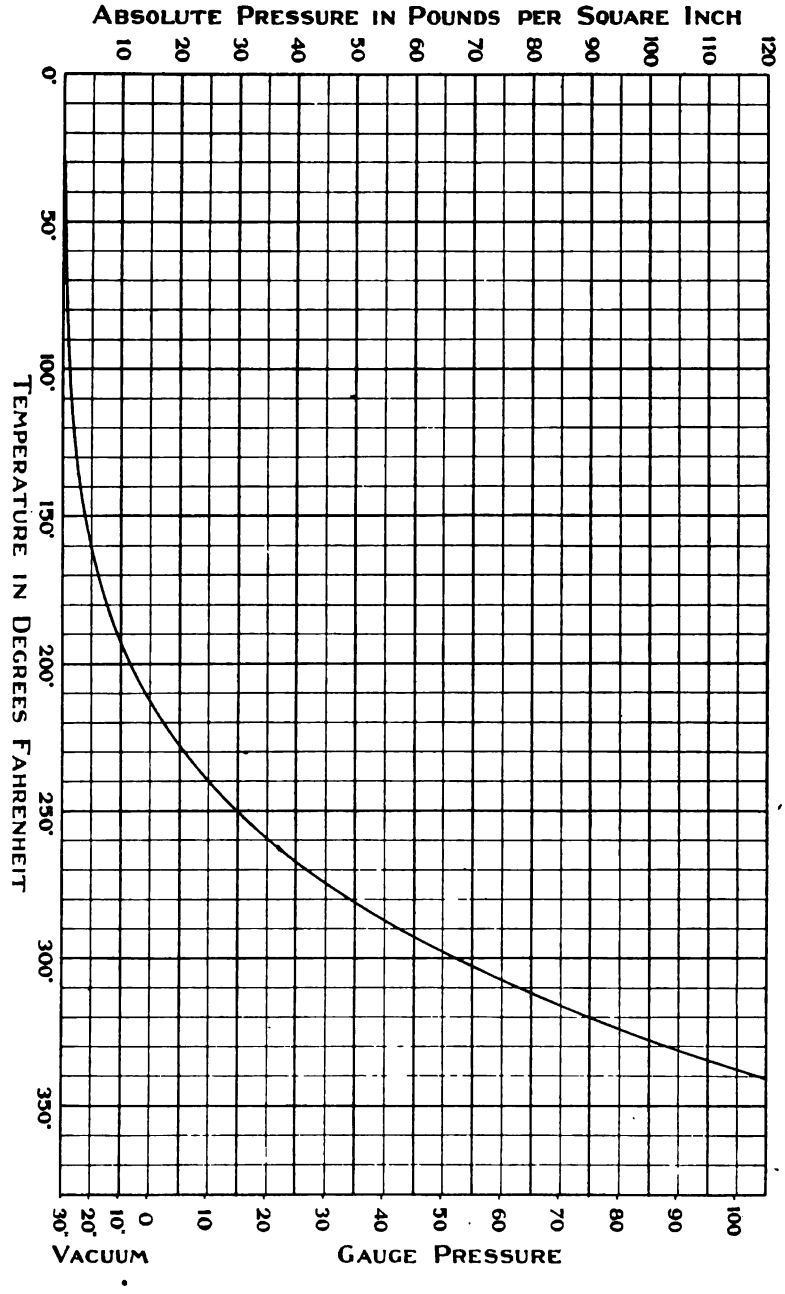

Absolute Pressure in Pounds per Square Inch
10
20
30
40
50
60
70
80
90
100
110
120
0°
50°
100°
150°
200°
250°
300°
350°
Temperature in Degrees Fahrenheit
30°
20°
10°
0
10
20
30
40
50
60
70
80
90
100
Vacuum
Gauge Pressure

FIG. I.

1154.9 — 180.8 = 974.1 B. T. U. per pound of steam at ten pounds pressure. $\frac{974.1}{1004.1}$=.97 or the heating value of steam at ten pounds gauge is 97 per cent. of that of steam at 100 pounds gauge.

High pressure steam then has the single important advantage of permitting a greater difference in temperatures, and thereby a corresponding smaller amount of heating surface.

Let us now consider briefly the effect of reducing the atmospheric pressure on or about the outside surface while still maintaining a low pressure on the inside. Figure I shows a curve plotted with the pressures of saturated steam as ordinates and the corresponding temperatures as abscissae. A reference to this curve shows the great advantage which decreasing the boiling point by means of a vacuum about the cans, has over the increasing of the pressure within the cans. It may be seen from the nature of the curve, that as the atmospheric pressure decreases, the temperature decreases to a much greater degree. As an extreme, a lowering of the pressure from two pounds to one pound absolute, or in other words increasing the vacuum from about 26 to 28 inches, gives a decrease of 24.3 degrees, while raising the pressure from 115 to 116 pounds absolute or about 100 to 101 gauge increases the temperature only 0.64 of one degree.

Let us assume 10 pounds gauge as the average pressure at which low pressure dry cans receive steam, and that the condensed steam leaves the cans at atmospheric pressure. The average pressure within the cans will then be somewhere between 10 pounds and 0 pounds. The pressure probably fluctuates greatly, steam being condensed, lowering the pressure, when an increased amount of steam rushing in raises it again. In Figure II it is assumed for the sake of comparison that the average temperature within the cans is that due to a pressure of 5 pounds gauge. A curve is then plotted having as ordinates the vacuum in inches from 0 inches or atmospheric pressure, up to 30 inches or an absolute vacuum. The corresponding pressures of saturated steam are used as abscissae and scales are

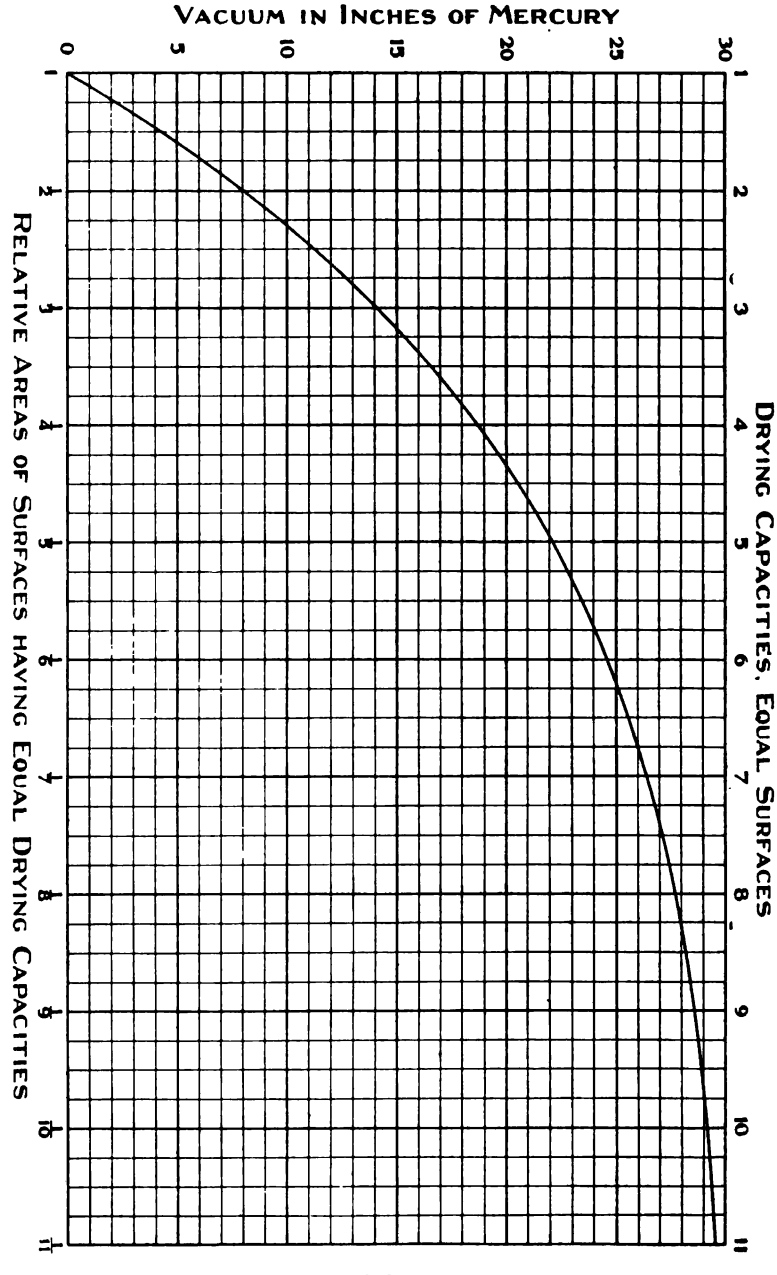

VACUUM IN INCHES OF MERCURY
0
5
10
15
20
25
30
1
2
3
4
5
6
7
8
9
10
11
DRYING CAPACITIES. EQUAL SURFACES
RELATIVE AREAS OF SURFACES HAVING EQUAL DRYING CAPACITIES
1
½
⅓
¼
⅕
⅙
⅐
⅛
⅑
⅒
1/11

FIG 2.

arranged at the top and at the botton to show the relative advantage of the different stages of vacuum in increasing the drying capacity or decreasing the amount of surface from that of our assumed reference case; a set of cans with the average internal pressure of five pounds gauge, drying cloth under atmospheric pressure. The temperatures of the outside surface of the cans is taken as that of the water in the cloth after it reaches the point at which ebulition takes place, and is that due to the pressure of saturated steam under the various conditions of vacuum. This holds true for all cans where evaporation is taking place but not for the first one or two cans, the heat from which is expended in getting the temperature of the water in the cloth up to the boiling point.

From this curve it may be seen that a vacuum of 28 inches would enable our cans to increase their product to more than eight fold, or to state it differently, the set of cans could be divided into eight equal parts and each part would when drying in a vacuum of 28 inches, have the full capacity of the original set or cans drying under atmospheric pressure. To illustrate this point as plainly as possible I have shown in Figure III the relative sizes of two cans having the same drying capacity, the one under atmospheric pressure, the other under 28 inches of vacuum. The straight lines in the same figure show the relative amounts of heating surface.

The resulting advantages are obvious. A large amount of space would be saved, a consideration of considerable importance in many places. Less power would be required. The cost of supplies such as oil and packing would be lower, and above all, there would be entire absence of heat or vapors in the room.

Although we cannot claim that vacuum drying would effect a great saving of steam under all circumstances, there is still a margin of profit in its favor. The amount of steam used for drying is proportional to the number of heat units which must be furnished to heat the water in the cloth up to the boiling point, and to evaporate it at that temperature. Taking the

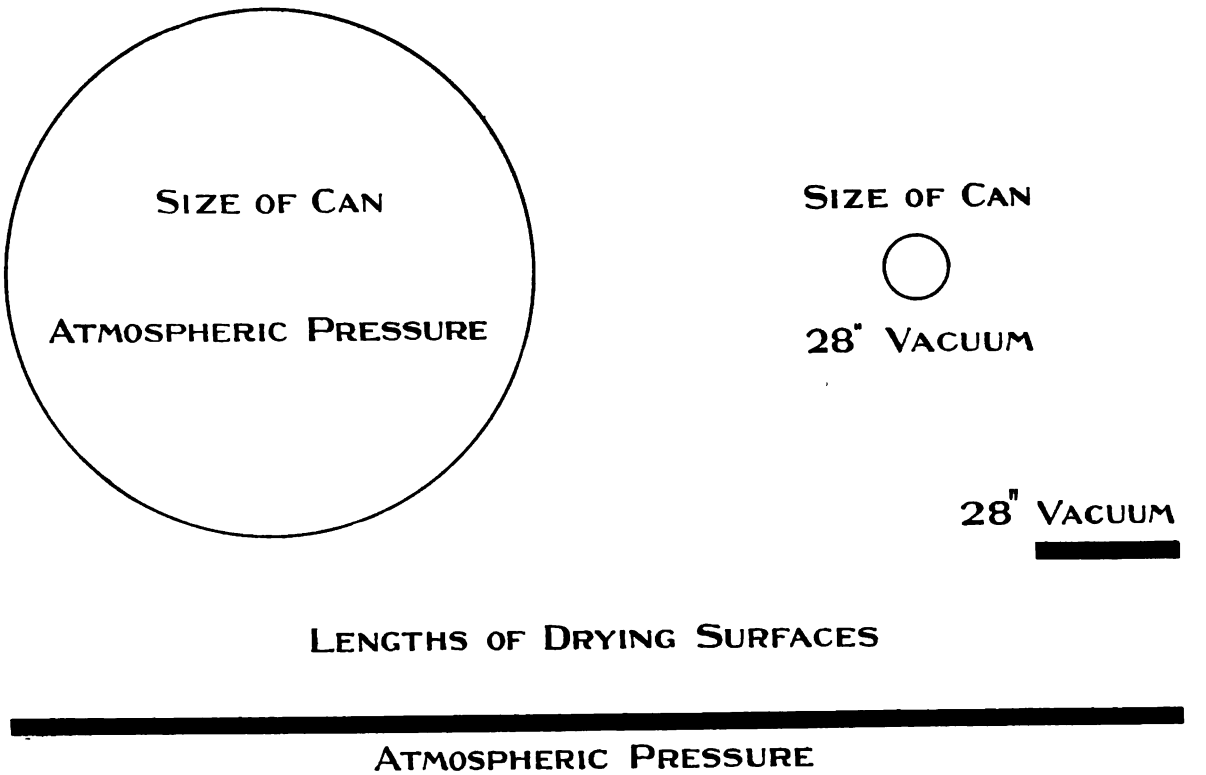

SIZE OF CAN
ATMOSPHERIC PRESSURE
SIZE OF CAN
28" VACUUM
28" VACUUM
LENGTHS OF DRYING SURFACES
ATMOSPHERIC PRESSURE

FIG 3.

temperature of the cloth as 70 degrees before drying, the heat units required per pound of water which it contains will be 1112.8 — 38.1 = 1074.7 for 28 of vacuum, and 1146.6 — 38.1 = 1108.5 for atmospheric pressure. This shows a theoretical gain of $\frac{1108.5-1074.7}{1108\ 5} = 3$ per cent. for 28 inches of vacuum.

In places where the amount of steam used for power is large in proportion to the amount of steam used for drying, a desirable indirect saving is possible by the use of a vacuum, as it will permit reducing the pressure of steam in the low pressure piping from say ten pounds to perhaps two pounds gauge. As this pressure acts as a back pressure on the engines a saving in power steam is effected.

Having satisfied ourselves that there are apparantly great advantages to be derived from the application of a vacuum to the drying of textile fabrics, it remains to be shown that a practical application of the theory is feasible, and that there is no serious falling off in the benefits which a theoretical study of the subject has led us to expect.

The experiments conducted with this end in view have, on the whole, been satisfactory. The apparatus used, consisted of an air tight chamber enclosing a set of nine 23-inch diameter dry cans, a part of a regular 40 can set. The cloth was admitted and passed out, through roller gates, so arranged as to allow a continuous passage of the cloth without stopping the machine or breaking the vacuum. A vacuum of upwards of 20 inches was maintained within the chamber, by a small vacuum pump, with a jet condenser attached. Different cloths in continuous webs were dried both with and without a vacuum in the chamber, and the results carefully compared. Although the apparatus was in a way crude and unhandy, an efficiency of about 65 per cent. of the theoretical results as shown by Figure II was obtained.

It is to be expected, that owing to the conditions of the first two or three cans there will be a slight falling off from the results of the curve. Another uncertainty which no doubt had

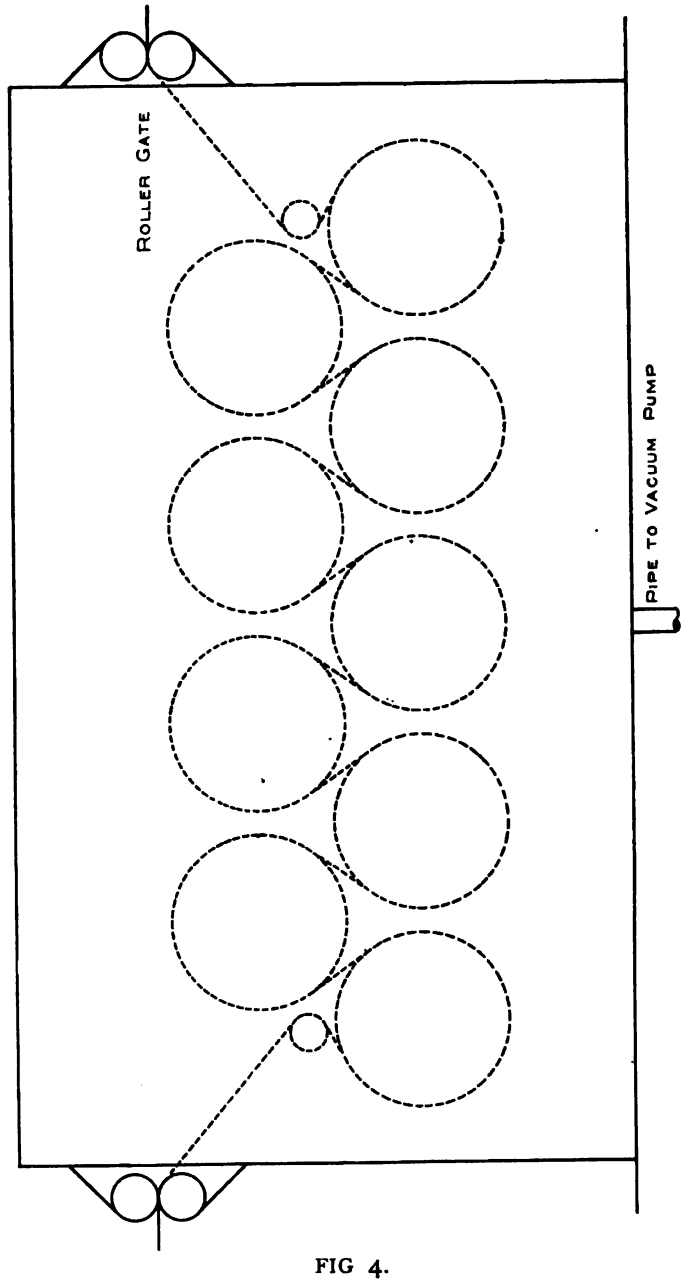


FIG 4.

its influence on the final results of the tests was the question of the dryness of the cloth. Unfortunately the limit of the capacity of the experimental machine was the limit of the speed of the engine which furnished the motive power and without doubt many of the cloths took more time than was actually necessary in passing through, they coming out, as it were, over-dry.

However this may be, the results are thought sufficiently satisfactory to warrant the building of a special vacuum drying machine, the practical working of which I trust, may so far bear out the theory, that the possibility of an apology as hinted in the opening of this paper, will be removed.

The PRESIDENT. I think the subject of the paper just read is one of very great importance to many members of the Association, and Mr. FISH, without doubt, is ready and willing to answer any questions, and any remarks to be made in regard to the matter will be very welcome. Mr. GRANGER would you like to say something?

Mr. WILLIAM S. GRANGER. No, sir. I am conversant with the subject to a certain extent only, but I can say from reading the paper that Mr. FISH is doing a great work, and I hope he will continue his experiment farther than he has. From the slight experiments which he has tried I am convinced it must be a success — not only a success in drying cloth but a success for other purposes. I hope he will continue the experiments farther and to a greater success.

Mr. LOUIS SIMPSON. I would like to have Mr. FISH kindly describe to us the kind of air chamber that he used and the kind of vacuum pump. I think the paper is a very valuable one and that is the reason I want all the information I can get.

The PRESIDENT. I presume Mr. FISH will be glad to give the information.

Mr. CHARLES H. FISH. Did you ask for the kind of vacuum pump?

Mr. LOUIS SIMPSON. Yes, and the description of what you experimented with.

Mr. CHARLES H. FISH. The experiments, as far as we have gone, were conducted in this manner: We made a circular boiler, for ease of construction, in which the cans were set. This boiler was made of boiler iron of sufficient strength with heads set in. To maintain the vacuum we used a common Knowles vacuum pump and a jet condenser to condense what vapors might come from inside the chamber. In the experimental machine which we are building, the outside casing is of cast iron, made square and of the right size, so the journals of the cans are a part of the outside casing. In making the first experiments, we took the first section of a set of dry cans and set them inside this chamber, sealed it up tightly and went ahead with that apparatus until we were convinced that a further expenditure was warranted.

Mr. FREDERICK A. FLATHER. I would like to ask Mr. FISH how he maintains the vacuum at the rolls on either end where the cloth enters and leaves, and how the bearings are make tight on each side of the machine so as to maintain the vacuum.

Mr. CHARLES H. FISH. The difficulty in making the machine was in the roller gates, as we call them. The gates consist of metal rolls, although we have used hard rubber rolls. The rolls are packed at the ends — the heads, so to speak; and the bearings are on the outside of the packing arrangement, so that the bearings do not interfere with the packing of the rolls. We used a metallic packing, which was cut in two semi-circles set together and forced against the end of the roll. Across the top

of the roll and across the bottom there was a packing sheet of hard rubber, which was held down partly with springs, but being on the outside of the roll, as soon as the vacuum was started it sucked against the roll. With the first roller gate that we constructed we got about 11 inches of vaccum, and that was about all we could get. However, after we made slight changes in the packing arrangements, we maintained 22 and 23 inches of vacuum for a considerable time on that machine. I expect eventually to get a very good mechanical arrangement for the roller gates. One difficulty that we ran into was that with this tremendous pressure caused by the vacuum, packing rings of all sorts were sucked against the rolls very hard, and the machine would run only perhaps fifteen or twenty minutes before the ends of the rolls and the surfaces would get hot. It was difficult to get just the right arrangement, but we have got it now so that the machine runs satisfactorily.

Mr. STEPHEN N. BOURNE. I was going to ask Mr. FISH about the expense of maintaining this vacuum pump — if that would not take off part of the per cent. he was saving.

Mr. CHARLES H. FISH. The expense of working the vacuum pump is very slight. I have figured that for my own satisfaction, but I should not want to give figures now, because with the experimental machine there was more leakage than there would be with the machine properly constructed. The pump was six inches by ten inches, and it ran very slowly to maintain the vacuum. It was a steam pump and exhausted into a low pressure system; but I would propose, where it could be done, to use a power vacuum pump, and the cost would be practically nothing; that is, it would be so very slight, when divided by the pieces of cloth or the yards of cloth which you would run through, you could hardly figure it. Of course this same arrangement which has been adapted to the drying of textile fabrics could probably be applied to the drying of yarns, slasher work, or in fact to the drying of anything. It might be a little more difficult to put yarn through the machine.

Mr. FREDERICK A. FLATHER. Mr. President, I would like to inquire if a great deal more power is consumed with this apparatus than with the ordinary machinery which is employed for this purpose, owing to the friction of the stuffing boxes and sheet packing which are used in maintaining the vacuum?

Mr. CHARLES H. FISH. These inlet rolls were only four inches in diameter, they were very small, and whereas the friction was considerable, it was on such a slight surface that the power which it required was apparently very light. We drove this experimental machine with 2½ inch belt, indifferently put on. The question never came up of the matter of power, because the machine ran easily. I should expect on taking for comparison a 40-can set — I say a 40-can set because we had one close by and we made the comparison — that the power would be very much less, perhaps ¼ of what it would be to drive the 40-can set, and you would do very much more work. I do not think that the question of power, either on the pump or on the machine, will be material. I am sorry I cannot go into detail, but I did not make tests of power used because the machine itself was so crude.

Mr. FREDERICK A. FLATHER. You spoke about the heating of the rolls; that is why I raised the question.

Mr. CHARLES H. FISH. Yes. If the rolls had large diameters and the packing rings had been extensive, of course it would have been like putting on a brake, but they are very small, and while there was a good deal of local heat there was comparatively little power used. We have got over that entirely now.

Mr. FREDERICK A. FLATHER. Are the drying cans packed at the ends of the air-chamber in the same manner that the delivery and feed rolls are?

Mr. CHARLES H. FISH. I do not know as I know just exactly what you mean.

Mr. FREDERICK A. FLATHER. Your drying cans run in bearings, I presume, and these bearings are on each side of the air chamber?

Mr. CHARLES H. FISH. Yes, on the machine which we are constructing. On this experimental machine we took a section of the frame and set frame and all inside of this air chamber.

Mr. FREDERICK A. FLATHER. The bearings and all?

Mr. CHARLES H. FISH. The bearings and all.

Mr. FREDERICK A. FLATHER. And you drove the shaft through the stuffing boxes?

Mr. CHARLES H. FISH. And then we drove the shaft through the stuffing box. In the new machine we have the bearings in the casing and there is a sheet packing arrangement so constructed that we do not anticipate any leak there whatever. Then the ends of the journals will stick out through the casing, and the packing boxes to prevent the steam from blowing out will be the same as in the present can.

Mr. LOUIS SIMPSON. The trouble which I see with this system is in the cleaning of the cans. What arrangement has Mr. FISH made so that men or boys can go in there to clean the cans? In print works you have not much cleaning of cans, but in dye works, unfortunately, we have, and in the same way with yarn. Would it not be rather awkward sometimes in case of yarn having got in the cylinder? It would destroy your vacuum each time and consume considerable time in getting the machine running again.

Mr. CHARLES H. FISH. Of course I am talking somewhat from a theoretical basis, because the real machine is not yet constructed. On this experimental machine we got inside and went all around. But the new machine as laid out, has doors in the casings opposite each can. The cans themselves are quite small.

The machine which we are constructing and upon which I expect to do at least four times as much work and prehaps six times as much work, is about as large as an upright piano — not much larger than a sewing machine — and a man can put his hand in through the casings and lay his cloth out as required. The breaking of the vacuum requires nothing but a switch or a slide valve, and you open that and the vacuum is gone in a second. The pump still works. You close it and the vacuum comes back in perhaps ten seconds; it is very quickly done.

Mr. FREDERICK A. FLATHER. Mr. President, does Mr. FISH know what the temperature was in that vacuum chamber?

Mr. CHARLES H. FISH. I made no tests of the temperature. I could tell quite easily theoretically what the temperature should have been. The outside casing was not hot; it was warm. You could put your hand against the casing and you would know there was heat in there, but you could hold your hand there with impunity. I should like to take a moment, and I think I can give you approximately what the temperature was. It would not vary materially from the temperature due to the vacuum as shown by the curve in the figure.

Mr. FREDERICK A. FLATHER. Well, it would be quite a little lower, would it not?

Mr. CHARLES H. FISH. Oh, yes, considerably lower.

Mr. FREDERICK A. FLATHER. You do not know just how much?

Mr. CHARLES H. FISH. I do not know without figuring it; no, sir.

The PRESIDENT. Is there still further discussion on this subject? If there is nothing more to be said we will take up the third paper on today's programme.

THE IMPORTANT FEATURES RELATING TO RING SPINNING AND COST OF SUPPLIES FOR PLAIN LOOMS.

ALFRED E. ADAMS, Whitinsville, Mass.

The ring traveler plays a very important part in the spinning of cotton yarns. At the present stage it cannot be dispensed with. It has been improved. It may be brought to a still higher standard of quality. Opinions differ as to the shape and temper. The round point traveler is very popular. Different widths of wire are used. Having tested many styles of travelers under varying conditions on various sizes and makes of rings, my experience is that a very wide traveler and small circle give the best results The wide wire stands more erect and runs more smoothly. At a speed of spindle approaching or exceeding 10,000 revolutions, a wide traveler demonstrates its advantages over a narrow traveler. In all the tests which I have made, the square pointed traveler has given the best results.

Good running spinning and good yarn are not entirely dependent on the ring traveler. The ring is another equally important factor. Rings, as well as ring travelers, have been and are being improved. Manufacturers of the spinning ring are, to my knowledge, making great effort to produce an absolutely perfect ring, regardless of expense. We, no doubt, would obtain wonderful results with absolutely perfect rings. Spinners often say that they reject all rings not perfectly round. Were this a fact, there would be very little spinning done on ring frames. We are told sometimes not to accept from the maker any rings not round. Those who are at all conversant with the manufacture of spinning rings will not give such advice.

More perfection in manufacturing spindles and ring rails, and the adjustment of these parts when the frame is set up, will assist our rings and travelers in producing more and better yarns. Give us ring rails that are short, perfectly straight and level, and stiff enough to obviate all vibration. In fact, build your mill so substantially that, when the machinery is set up and running, there will be the least possible amount of vibration. A spinning frame that vibrates very much will cause the rings and travelers to wear rapidly as well as the other parts of the frame.

The very high speeds at which many are running machinery make it necessary that machinery should be more perfectly built, and when set up in the mills, correctly adjusted. A higher speed of spindles for ring spinning is obtainable and practical. Twelve thousand revolutions is not above what spindles ought to run on medium and fine counts. To do this successfully, improvements can and must be made in building the ring frame. All spinning frames should have adjustable feet for ends and sampsons. This would simplify the leveling and cause it to be done more frequently. No one doubts the importance of keeping the machinery level.

Top rolls might be improved and made to run more smoothly. This would apply to all machinery on which top rolls are used. It is possible that a shell roll having ball bearings will come into use. Such a roll would need no oil and would run smoothly. Tests have been made which showed very marked improvement in the evenness of the yarn. With such a roll 50 per cent. of the weight could be done away with, power would be saved, or an increased speed obtained without increasing the power. Ball bearing rolls have been in use for over two years on fly frames and the results have been excellent. Tests show a large saving in roll covering, at least ten per cent. in power, and smoother work. It is not necessary for me to indicate in this paper all the improvements which I think should be made in building the ring frame. Suffice it to say that improvements are being made, and more will be made when the manufacturer

demonstrates clearly to the builder what is wanted, or more properly, what is practical.

The tables on ring travelers are not what I would have them, or what they might have been had the members of the Association complied with my request more fully. The tables attached to this paper may give an idea of the cost of travelers under varying conditions in different mills. Statistics on travelers might be obtained by some one through the assistance of the members of this Association that would be interesting and instructive. I am very sorry not to have been able to present the subject of travelers more fully. In presenting such an important subject it is extremely necessary to have all the facts. I desire to thank this Association for the information sent me relating to ring travelers. I hope this important subject will not be dropped, but that some one will take it up and complete, with the assistance of the members of the Association, what I have attempted to do.

Attached are tables showing something of what was attempted.

No.	Number Yarn. Warp.	Fil'g.	Spindles. No.	Make.	Speed.	Rings. Size.	Yrs. in Use.	Travelers. No.	W'gt.	Cost per M Spds. a year.	Trav. erse of Rail.
1	. . .	36	3200	Grav.	8433	1¾	3			$9.01	6 in.
	16-30	. . .	43195	"	9200	1⅝	8²				5½ "
	92% of spindles on No. 28 warp.										
	14-20	. . .	2852	Grav.	8600	1⅝	15			5.18	6 "
	20-28	. . .	13068	"	9200	"	"				
	30-36	. . .	5011	"	8600	"	"				5½ "
	40-45	. . .	1857	"	8000	"	"				
	. . .	12-18	1504	"	8000	1 5-16	12			3.75	
	. . .	36	23472	"	7750	"	"				
	. . .	40-41	5475	"	9000	"	"				
	Cost of travelers based on 8½ years.										
2	28	. . .	1450	Grav.	9200	1⅝ in.		2/0	Grs. 10=8	15.60	6 "
	35	. . .	204	"	"	"		4/9	10=7	6.09	6 "
	45	. . .	1633	"	"	"		7/0	10=5²		6 "
	50	. . .	11466	"	"	"		"	"	8.00	6 "
	60	. . .	582	"	9000	"		"	"		6 "
	65	. . .	15673	"	"	1⅜ "		12/0	10=4¹		6 "
	65	. . .	4694	"	"	"		"	"		6 "
	75	. . .	4750	"	"	"		"	"	15.80	6 "
	80	. . .	4401	"	"	"		"	"		5½ "
	90	. . .	3591	"	"	"		"	"		5½ "
	90	. . .	1337	"	"	"		14/0	10=33	18.80	5½ "
	100	. . .	5063	"	"	"		"	"		5½ "
	One-half of the rings used 8 years; one-half used 2 years.										
3	21	. . .	32000	Grav.	8500	1⅞ "	3	4/0	10=7	8.18	6½ "
	29	. . .	32000	"	"	"	"	8/0	105-¼	23.60	6½ "
	10 M of the 64 M were used 6 years.										
4	45-60	. . .	15800	Grav.	9500	1⅝ "	1	12-14/0		50.50	6 "
	30-40	. . .	15800	"	"	1¾ "	"	10/0			6½ "
	New mill. Do not use half the number of travelers on 30's that are used on Nos. 50 to 60's.										
	30-45	. . .	32000	Grav.	8500	1⅝ "		8-10/0		5	9.4¼ "
	Old mill. Rings in use a number of years.										
5	23	. . .	40000	Grav.	8600	1¾ "	7	2/0	10=8	3.60	6 "
	Cost of travelers based on one year.										
6	28-30	. . .		Grav.	9300	1⅝ "			10=6		6 "
	. . .	30	46184	"					10=5²	13.13	5½ "
	. . .	34-36		"	9300	1½ "			10=3		5½ "
	Rings used several years; cost of travelers based on last year.										
7	10-29	. . .		"		1 15-16		1 10/0			
	. . .	5²-36	About	"		to 2 in.		1-11/0			6½ "
	29	. . .	50000	"	8000	1⅝ "		6/0	10=6	5.50	
	. . .	38		"	8500	1 5-16		11/0	10=4²		
	Rings used from 5 to 10 years; cost based on last year.										
8	30	. . .		"	9600	1⅝ in.	9	3/0	10=7²		6 "
	. . .	40	41920	"	9000	1¼ "	9			8.25	5½ "
9	27	. . .	7000	Sawyer	6500	1⅝ "	10	4/0	10=7	1.95	5½ "
	Cost of travelers based on last year.										
10	22	. . .			7400	1⅞ in.	3	4/0	10=7	8.75	6½ "
	Cost of travelers based on last year.										

No.	Number Yarn. Warp.	Fil'g.	Spindles. No.	Make.	Speed.	Rings. Size.	Yrs. in Use.	Travelers. No.	W'gt.	Cost per M Spds. a Year.	Traverse of Rail.
11	28[2]	. . .	34080	Grav.	9325	1 5/8 "	4	9/0	10=5	8.17	5½ "
	"	. . .		"	9050	1 7/8 "	2				6½ "
	Cost of travelers based on last year.										
12	38	. . .		"	9350	1 5/8 "	2	17/0	10=3	18.62	6 "
	Cost of travelers based on last year.										
13	6[2]	. . .			6100	2 "	3	10	10=26	7.96	7½ "
	1542 Grs. yarn on bobbin. Cost of travelers based on last year.										
	2159 Grs. weight bobbin and yarn.										
14	12-28	. . .	7040	Pearl.	7200	1 5/8 "		1/0–8/0		8.88	5½ "
	. . .	26	43000	Grav.	8800	1 5/8 & 1¼ "					to 7"
	All rings renewed within 10 years. Cost of travelers based on last year.										
15	28	. . .	24128	"	9000	1 5/8 "	8	8/0	10=5[1]	18.00	5½ "
	Cost of travelers based on 8 years.										
	Rings that are in use have been in use 16 years; 8 years on each flange. Speed of spindles, first 8 years, 7600; second 8 years, 9000.										
16	28	. . .	17600	"	9600	1 5/8 "	5		10=7½	12.45	6½ "
	More travelers used on 6½ than 5½ traverse. Cost of travelers based on 4 years.										
	Cost of travelers when running Sawyer spindles at 7200 revolutions was about half.										
17	26	. . .	20672	"	9100	1¾ "	2			9.38	6½ "
	48	. . .	17088	"	9100	1 5/8 "	2			7.11	5 1-6
	. . .	36	12320	"	8500	1 3/8 "	2			21.02	
	Cost of travelers based on last year.										
18	28	. . .	8064	"	9500	1¾ "	4	6/0	10=6	16.05	6½ "
	. . .	36	2016	"	9500	1¾ "	4	10/0	10=43	10.72	5½ "
	Cost of travelers based on last year.										
19	32	. . .	12605	Sawyer	8000	1 5/8 "	10			9.45	6 & 7
	32	. . .	7469	Gray	9400	1 5/8 "	10				
	. . .	34	3270	Sawyer	7100		10				5½ "
	Cost of travelers based on last year.										
20	18[2]	. . .			6100	1 5/8 "	12	1	10=10	6.42	5 "
	. . .	13[2]			6500	1 5/8 "	2[2]	2	10=12	6.16	6 "
	. . .	12[2]			6500	1 5/8 "	2[2]	5	10=14	6.93	6 "
	11[2]	. . .			7200	1 7/8 "	12	8	10=20	7.75	5 "
	11[2]	. . .			8000	1 7/8 "	2[2]	8	10=20	7.39	6 "
	Cost of travelers based on last year.										
21	40	. . .	16844		9200	1 5/8 "	3	8/0	10=5[1]	14.08	5½ "
	45	. . .	2887		9200	1 5/8 "	3	to			&
	50	. . .	3609		9200	1 5/8 "	3				6 "
	60	. . .	724		9200	1 5/8 "	3	22/0	10=13		
	First year's cost for travelers, $40. Cost based on last year.										
22	18[2]	. . .	9648	Eureka	8500	1¾ "	8	3/0	10=7[2]	3.29	6 "
	18[2]	. . .	7520	Sawyer	6800	1¾ "	6	3	10=12		5½ "
	. . .	19[2]	11936	"	6200	1¾ "	6	1/0	10= 9		6 "
	. . .	19[2]	3328	"	6200	1 3/8 "	6	3	10=12		6 "
	Cost of travelers based on last year.										
23	25	. . .	74000		6900	1¾ "	12			4.77	6 "
			5000		9200	1 5/8 "	12				
	Cost based on last 5 years.										
24	27[2]			Grav.	10200	1¾ "	3	11/0	10=4[2]	37.36	6 "
	38			"	10800	1¾ "	5	14/0	10=33	30.93	6 "
	Cost of travelers based on last year.										

Spindle banding, in my opinion, needs careful attention. We can waste power and wear out our spindles very rapidly if the banding is not properly made and put on the spindle with some judgment as to tension, and the proper tieing of the knot. A large band is not necessary, especially when spindles are properly lubricated with a light and good quality of oil, and the spindles removed from the bolster casings and bolsters cleaned at least once in two years. I have this done oftener. With a proper system, it will be very little trouble and no additional expense to give spindles the best of care. I have had many inquiries about my small bands and how such good results were obtained. Those inquiring have sent me samples of the bands which they were using and the results obtained by them. It was interesting to note the difference in different mills, using the same spindles under nearly the same conditions. One party was using 60 pounds of banding; others 42, 31 and 20 pounds per thousand spindles per year. Number of bands was from 50 to 110 per pound. In one mill, they were using sperm oil on their spindles. In this mill, the pull on the band was from 12 to 16 pounds. The bands were very large in this case. Spindle banding in some mills certainly needs investigation. I might mention many things bearing upon the use and abuse of spindle banding, but enough has been said to introduce the subject. The following table shows the results for a series of years in one mill.

TABLE ON BANDING.

No. 1 MILL.

BANDING FOR RING SPINNING, 1897.

Number of spindles, 5,646. Revolutions per minute, 9,500. Number of bands used, 6,546.

Average number of bands per 1,000 spindles per yard, 1,160. Life of band, 10.34 months. Banding used per 1,000 spindles per year, 9 lb.

Number of bands per pound when made, 129; when on frames, 153.

Bands put on spindles with a tension of 2½ pounds.

Length of bands when made, 57 inches. 9 inches cut off when put on.

No. 1 Mill. STATEMENT OF BANDING USED.

Year.	No. Bands.	Pounds.	Bands Per 1000 Spindles.	Pounds Per 1000 Spindles.
1890	6771	45.14	1110	7.40
1891	7981	53.20	1309	8.72
1892	6816	45.44	1118	7.45
1893	6934	55.47	1137	9.09
1894	5647	45.17	926	7.41
1895	8271	66.17	1357	10.85
1896	6812	51.21	1117	8 40
	7)49232	361.80	8074	59.32
	7033+	51.68	1153+	8.47+

This statement is based on 58 hours per week.
All bands are marked when made, and knots are tired on the mark.
Spindles are all set on a line in bolster rails, and are not adjustable.
Number spindles, 6096. Average life of band, 10 months and 15 days.

No. 2 Mill.

Banding for Ring Spinning, 1897.

Number of spindles, 6,400. Revolutions per minute, 9,734. Number of bands used, 9,303.

Average number of bands per 1,000 spindles per year, 1,460.

Banding used per 1,000 spindles per year, 9.32 pounds.

Number of bands per pound when made, 200; when on frames, 230.

Bands put on spindles with a tension of 2½ pounds.

Length of bands when made, 51 inches. 6 inches cut off when put on.

Life of bands, 8.22 months.

No. 30 warp; 1¾ inch rings; 6-inch traverse.

Supplies constitute an important item of expense in the running of a cotton mill. In order to introduce this subject, I have prepared a table and attached the same to this paper. The table will explain itself.

STATEMENT OF SUPPLIES USED ON 300 40-INCH LOOMS, FOR YEAR ENDING JANUARY 1, 1898.

	Quantity No.	Price	Total Cost.	Cost Per Loom Per Yr.	Days Durability.	Used Per Loom. Based on 300 dys. a yr.
Shuttles, dozen	10	$4.00	$40.00	.1333	386	3 5 of a shuttle.
Shuttle Spindles	50	.13	6.50	.0216	1800	1-6 of a spindle.
Shuttle Springs	300	.03	9.00	.0300	300	1 spring.
Temples, pairs	15	2.80	42.00	.1400	20*	1-20 of a pair.
Temple Burrs, long	14	.37[2]	5.25	.0175	6300	1-21 of a temple.
Temple Burrs, short	12	.20	2.40	.0080	7500	1-25 of a temple.
Top Harness Hks. gr.	1 1-13	1.05	1.40	.0046	280	1 1-16 of a hook.
D. J. Hooks, gross	3 2-3	3.50	12.83	.0428	127	1.59 hook.
Picker Sticks	900	.04	36.00	.1200	100	3 sticks.
			$155.38	$ .5178		
Loom Dusters, dozen	8	1.50	12.00	.0400	938	8-25 of a brush.
Floor Brushes, dozen	1 1-4	.75	.94	.0037	6000	1-20 of a brush.
Sponges	38	.02	.76	.0025	2368	19-150 of a sponge.
Screw Eyes, gross	2 1-6	.55	1.19	.0040	281	1 1-15 of a screw eye.
Harness Twine, lb.	2 1-3	.75	1.75	.0058		
			$16.64	$ .0560		
STRAPPING.	No.	lb.				
Lug Straps, long	120	37	.40	14.80	.0493	818	11-30 of a lug.
Lug Straps, short	200	20	.40	8.00	.0266	450	2-3 of a lug.
Sweep Straps, long	20	1 2-3	.38	.63	.0021	4500	1-15 of a strap.
Sweep Strap, short	201	7-13	.38	.58	.0016	4500	1-15 of a strap.
Heel Straps	100	10	.40	4.00	.0133	900	1-3 of a strap.
Jack Straps	30	6	.40	2.40	.0080	3000	1-10 of a strap.
Top Harness Straps	50	3 4-7	.38	1.36	.0045	1800	1-6 of a strap.
Belly Strips		10	.25	2.50	.0083	9000	1-30 lb. belly strips.
				$34.27	$ .1137		
Pickers	850	121	.35	42.35	.1412	107	2 8-10 of a picker.
Picker Collars	600		.01	6.00	.0200	150	2 collars.
				$48.35	$ .1612		
Belting, 1 7-8, s. ft.		100	.36	36.00	.1200	900	1-3 ft. of belting.
TOTAL COST.				$290.64	$ .9687		

* This is years; all others are days.

Average Weights Strapping.		Strapping For One Plain Loom.	
Long Lug Straps	3 per pound.	Long Lug Straps	2
Short " "	10 " "	Short " "	2
Long Sweep "	12 " "	Long Sweep "	2
Short " "	13 " "	Short " "	2
Heel "	10 " "	Heel "	2
Jack "	5 " "	Jack "	2
Top Harness "	14 " "	Top Harness "	4
Pickers	7 " "	Loop "	2
		Friction "	1
All strapping made from best oak-tanned leather.		Lease Rod "	2
		Pickers	2
		Collars	2
			25= 2½ lbs.

BEST OAK-TANNED LEATHER, COST $1.00.

STATEMENT FOR SIX YEARS ENDING JANUARY 1, 1897.
300 40-INCH LOOMS. AVERAGE PICKS, 162.

KINDS OF SUPPLIES.	AMOUNT SUPPLIES USED.		PRICES	TOTAL COST.	1 LOOM 6 YEARS	1 LOOM 1 YEAR.
		Doz.				
Shuttles		47 7-12	$4.00	$190.33	.634+	.106—
Shuttle Spindles		289	.13	37.57	.125+	.021—
Shuttle Springs		1775	.03	53.25	.177+	.021+
Temples, pairs		288	2.80	806.40	2 688	.448
Temple Burrs, long		85	.37[2]	31.88	.106+	.018—
Temple Burrs, short		75	.20	14.80	.049+	.008+
STRAPPING.	No.	Lbs.				
Lug Straps, long	1239 =	413	.40	165.20	.551—	.092—
Lug Straps, short	1599 =	160	.40	64.00	.213+	.036—
Sweep Straps, long	149 =	12	.38	4.56	.015+	.003—
Sweep Straps, short	132 =	10	.38	3.80	.013—	.002+
Heel Straps	1295 =	109	.40	43.60	.145+	.022+
Jack Straps	275 =	55	.40	22 00	.073+	.012+
Top Harness Straps, plain	370 =	26	.38	9 88	.033—	.006—
Top Harness Straps, 3 leaf	30 =	3	.38	1.14	.004—	.001—
Top Harness Straps, 5 leaf	50 =	3	.38	1.14	.004—	.001—
Spring Straps, 5 leaf	650 =	16	.38	6.08	.020+	.003+
Salvage Straps	107 =	7	.38	2.66	.008+	.002—
Belly Straps		60	.25	15.00	.050	.008
Pickers,	5802 =	329	.35	290.15	.967+	.161+
Picker Collars,	3998		.01	39.98	.133+	.022+
Picker Sticks,	6181		.04	247.24	.824+	.137+
Picker Screws, gross	40		.74	29.60	.098+	.016+
Top Harness Hooks, gross	8		1.05	8.40	.028	.005—
No. 7 D. J. Hooks, gross	22		3.50	77.00	.290	.045—
Hooks for 5 Harness	3[2]		1.00	3.50	.011+	.002—
Loom Dusters, dozen	65[11]		1.67	109.39	.365—	.061—
Floor Brushes, dozen	5		9.00	45.00	.150	.025
Brushes for Weak Drawing,	4		.25	1.00	.003+	.0005
Wire Heddles,	2000		5.00	10.00	.033+	.0055
Screw Eyes, gross	13		.55	7.15	.024—	.004—
Harness Twine, pounds		14	.75	10.50	.135	.006—
Curtains	42		.15	6.30	.021	.003+
Sponges	228		.02	4.56	.015+	.003—
Toilet Paper, rolls	279		.07[2]	50.93	.169+	.028—
Bars Soap, Ivory	156		.04	6.24	.021—	.003+
Boxes Fusees	28					
Water Pails, cedar	2		.75	1.50	.005	.001—
Fire Pails	23		.25	5.75	.019+	.003+
Loom Belting, 1⅞ inch Single	794 ft.		.36	285.84	.952+	.159—

All new temples put in since 1891. Life of temples should be at least 20 years
All strapping made from best oak tanned leather.

My aim has been to make this paper brief, in order that there may be time for discussion. A full and free discussion should be encouraged, if the object of this Association is to be gained.

The PRESIDENT. Doubtless the majority of the members of the Association will remember that Mr. ADAMS' paper presented today is a continuation, as it were, of the paper that he read at our last meeting in Boston. He tells me that he sent out a very large number of letters of inquiry and received but comparatively few replies. It seems to me that it is a question of sufficient importance that the members of the Association at least should take interest enough in the inquiries made by him or any other member taking this matter up to give him the benefit of their experience and knowledge respecting this particular question. I have asked him in behalf of the Association to continue his investigations and at some future time to give us another paper upon this subject, and I doubt not that he will gladly do so provided his efforts are seconded by the members of the Association in giving him such information as they may have at hand; and I would very strongly urge the members, if those inquiries are made in the future, to put themselves to the inconvenience that it may cause them to answer those questions. I think the final result would be so satisfactory that none of us would feel that we had wasted time and postage in giving that information. This subject is before the meeting and open for discussion.

Mr. GEORGE OTIS DRAPER. Mr. President, there is one mention in Mr. ADAMS' paper of the known imperfections in spinning rings. I think some of the members here present may remember that in Philadelphia a year ago I explained some of the difficulties in the manufacture of spinning rings that occurred, so that it was almost impossible to make them round. Since that time an invention has been called to our attention with which we have been experimenting, that promises to produce an absolutely round ring. I should not say anything about it at this time if it had not been called up, because we shall not be ready to put those rings on the market for several months. We have already made several thousand and then our machine broke down. We also found when we started to make these absolutely

perfect rings that the present system of holding rings in the spinning frame would get them out of shape again; that is, the holder that holds them at different points against each other will contract the ring so as to make it oval, and we have had to make a new series of dies to produce a new series of holders, which, after we get an absolutely round ring, will hold it round. And when I say round this time — I have said we made round rings before, and they were round in comparison with any rings known then; but this time, with this new process, these rings will be round so that by any known system of measurements that any spinning frame overseer is likely to put them to it will be absolutely impossible to detect any error. We have made them so fine that it took measurements down to several thousandths of an inch to detect the slightest difference in the circumference. I merely mention this as a matter of interest. As I say, we shall not be ready to market these for several months, and when we do put these rings on the market we shall give a guarantee with them that any rings that are detected to be imperfect may be thrown out and sent back; and for that guarantee and the extra process we may very likely have to add an extra charge. [Laughter.]

Mr. FREDERICK A. FLATHER. I would like to ask Mr. DRAPER what he means by taking measurements down to several thousandths of an inch to detect the error.

Mr. GEORGE OTIS DRAPER. I mean by that, Mr. FLATHER, that an error within $\frac{1}{2000}$ or $\frac{1}{3000}$ of an inch is getting down so fine that it takes pretty fine measurement on the circumference of a ring to detect it. I am not getting down to ten-thousandths but within $\frac{1}{2000}$ or $\frac{1}{3000}$ — as near as the average men can detect it.

Mr. FREDERICK A. FLATHER. I do not think two or three thousandths is very near. I should like to ask Mr. DRAPER what his method is of making the rings.

Mr. GEORGE OTIS DRAPER. Well, Mr. FLATHER, if you take the percentage of $\frac{2}{1000}$ on a ring of 1¾ inches you are getting a pretty fine percentage. And if all the work turned out in our machine shops were on that percentage on articles of those dimensions I think we should be getting to pretty fine measurements, especially when you take the ordinary rings known to the trade that are out of round several hundredths, usually. When they are sprung into these plate holders they will be held in shape. As to the process, I think I am safe in describing part of it, though as our present machine was unsuccessful we may have to make some changes. The process consists in taking a ring that has been hardened and tempered, and re-heating that ring to a cherry red heat and forcing it on a plug of the exact shape and practically stretching the ring while it is hot on that plug, and then cooling it on the plug. And when it cools in that stretched condition all the strains equalize themselves around that absolutely cylindrical plug, and the ring is cooled in that condition and in that position, and after it is cool it does not change. That is about the way we do it at the present time.

Mr. FREDERICK A. FLATHER. I would like to inquire if I understand Mr. DRAPER that the ring does not change at all after it is taken from the plug?

Mr. GEORGE OTIS DRAPER. So far as we have seen we have not been able to detect any variation. Of course the plug itself may be a hair out of round or a little out of round, especially going through this heating and cooling which it must to some degree; but we are getting it down to a pretty fine point. In fact, when I say getting it down to a fine point, we found after we had made these rings that we had no tools with which we could detect the errors, and had to go to work and make an absolutely particularly accurate set of gauges in order to detect these errors. There was nothing in our shops that could detect them until we had made some special gauges for the purpose.

Mr. FREDERICK A. FLATHER. I should like to ask Mr. DRAPER, Mr. President, what the use is of making a spindle ring within a thousandth of an inch of error when the spindle is $\frac{1}{16}$ out of centre with the ring?

Mr. GEORGE OTIS DRAPER. In reply to Mr. FLATHER I will say the reason we want to make these rings round is because this Association has practically asked us to. There has been so much talk about round rings here that we have tried to make a product that would meet the views of the Association and the views of the manufacturers in general, and I think if we get each part up to its highest degree of excellence they gradually will all unite in producing a better effect. I can see, of course, that if the spindle is out of centre the round ring will not practically have so much impression as it might, but it certainly all tends in the proper direction.

The PRESIDENT. The members of the Association may feel flattered that a firm that has done as accurate work as the Drapers have had the reputation of doing has taken notice enough of their requests to make this strenuous effort to perfect a ring; and I presume if they make the same request of the Lowell Machine Company and other builders of spinning machinery, perhaps eventually we will get the spindle nearer than $\frac{1}{16}$ of an inch to the center of the ring, and if we continue that the manufacturer will get some benefits from the existence of this Association, the very thing that we have been striving for since its organization. And it strikes me that Mr. DRAPER'S remarks in this matter simply show that our efforts have not been entirely in vain, and it is to be hoped that the good work may continue until very many of the imperfections that we find in machinery may be removed.

Mr. FREDERICK A. FLATHER. Mr. President, I would like to ask a question of Mr. ADAMS which was asked me a few weeks ago by one of the members who usually comes here and takes active part in these meetings; the question is not original

with me. On page 4, in the table, in Section No. 1, we have: warp, yarns from 16 to 30; speed of the spindle, 9200; cost per thousand spindles per year for travellers, $9.01. That is on a 1⅝ inch ring. On the same sized ring, same speed, on the 4th line, from 20s to 28s, which perhaps would average about the same, the cost is only $5.18 as compared with $9.01. In the first line of Section 2, No. 28, 9200 revolutions of the spindle, 1⅝ inch ring, conditions almost the same, the cost ran up as high as $15.00, and further down in Section 6, 28s to 30s, spindle running 9300 revolutions — nearly the same, a little faster, rather — the ring was 1⅝ inch also, and the cost was $13.13. There, under apparently the same conditions, we have a cost of $5.18, $9.01, $13.13 and $15.60 for the same thing. I would like to know if Mr. ADAMS has any idea of why in some places they cost so much and in others so little?

Mr. ALFRED E. ADAMS. Mr. President, I have some idea what might be the reason for that difference. The condition of the rings is one thing that might make a difference; the time that the rings have run is another, whether they have been in use one or three years is another. The stock being used might make a difference. The tables are from different mills, and as you know, it gives in some cases the average for a number of years, in other cases for one year. That is wherein this table is not as complete as it should be, for what we would all like to get at is comparison, and it could be carried out more fully if every spinner could start with the rings when they were new and know exactly about the travelers that are used the first year, and the second, and so on through, the life of the ring and give the percentage used every year; then we should have something that we could compare with each other. In many mills they are on a variety of numbers of yarn and changing very frequently it might not be so practical in a case of that kind.

Mr. STEPHEN N. BOURNE. I would like to ask Mr. ADAMS if he thinks it is a good plan to economize on travelers — try to

make them last as long as you can. It seems to me it is a rather poor place to economize. After a traveler runs a certain time you take it off and the frame will run better with new travelers on. A traveler is no great expense in your six months' account; it does not cut much of a figure in the cost.

Mr. ALFRED E. ADAMS. I do not know in one way of looking at it, that it is a practical thing to economize on travelers, but at the same time it seems to me that the less piecings we have and the less waste we make, the better it is for the spinning. I believe that if travelers will run smooth and a long time it is better for the mill. In one case, where they are spinning from 50s to 60s, the first year the average cost per thousand spindles was $50. I know of mills where it has been as high as $100. Now when the cost gets up to that point it is quite an important item. My experience has been that it is a good idea to change the travelers when very heavy travelers are used, of course under different circumstances, at different times. I think it is a very good idea to change them before they wear out. That has been my practice on coarse numbers where a heavy traveler is used.

The PRESIDENT. If there is no more discussion on that topic we will take up the next topical question

No. 104. "What is the best manner of putting up goods for print works and bleacheries, and how should they be covered for protection in transit?"

I suppose somebody must have had some interest in that question, or it would not have found its way among our inquiries.

The SECRETARY. Mr. President, that question was sent to the Association by Col. FREDERICK T. WALSH, who, for reasons that we must all concede is not with us today.

Mr. CHARLES H. FISH. Mr. President, I would like to say a word on this subject because I look at it from the same stand-

point as Mr. WALSH does. We have to buy at Cocheco a great many cloths, and they come to us, not always, but almost always, in rather bad condition. They are not much damaged as a rule; if they are the mills usually hear from it; but they have a habit of baling the common grades of cloth — print cloths or perhaps a little better than that — by getting burlap, coarse gunny-bagging or something of that sort on the sides of the bale and nothing over the ends, and they are so tossed around in the cars, that when the bale is received by us it is very dirty often and it is a wonder to me that there is not more damage done. Many times my attention has been called to bales of cloth at first sight of which you would naturally say, "Don't touch them at all, they are not worth opening;" but if you cut the bale open and take the pieces out separately they are perhaps in very much the same condition as the leaves of a book, the edges look very badly when the book is closed, but if you open each individual leaf you will find it is not much damaged. But it seems to me for their own sakes the shippers of cloth should protect the ends of the cloth as well as the sides and use something for material a little better than the bagging from their cotton bales.

Mr. STEPHEN N. BOURNE. When I was in charge of bleach works and sent goods to a bleachery, I wove the cuts as long and with as few seams as possible, sent the cloth in rolls and covered the ends. It is more important that the ends than the outside should be covered. If the outside gets soiled a little, and there is any damage, it is only one piece, a yard or two, but the selvedges, are the hardest places to get the dirt off. Many times in the bleach works we used to get tar marks from the car, and all that sort of thing. A good many goods have been damaged in this manner. If the bleach works always received the cloths made in long cuts and put up in rolls with the ends protected, they would be easily handled and there would be fewer remnants and less seams to make; and if the printers should have their print cloths woven in about eight or nine cuts in a roll, there would be many less seams correspondingly

for their printing machines to contend with. With the new Northrop loom they can make about two rolls of cloth to a section beam.

The PRESIDENT. Is there anything further to be said? In our own experience the demand of the buyers as well as of the finishers of goods at the present time is for longer cuts — the longer the more desirable — and in order to put up the long cuts to send them away at all it is absolutely necessary to put them in rolls. And as Mr. BOURNE has suggested, when cloth is transported in rolls, if there is any damage at all it will simply be at the ends and perhaps one or two wraps around the outside of the bale, and that can easily be protected by putting a burlap around that as we have done on the outer sides of the ordinary square bale. It seems to me that there might be a device that would protect the ends with but very little expense to the shipper, and if the bales were rolled and properly burlaped and the ends protected in some simple form, the finisher of the goods would get all that he desired and the shipper of the goods would save a great many yards of goods and a great deal of annoyance by that method. I think the day is near at hand when the most of our goods will of necessity be rolled rather than folded as in the past, from the fact that, as I first mentioned, the converters — and a very large proportion of our goods today are sold to converters rather than over the counter as in the past — the converters want as few tailings as it is possible to have when they cut the goods up, and of course we can readily see the longer the piece the fewer ends, consequently the less waste to them. I think the time is near at hand when we shall all be obliged to make longer pieces, and as a result of that be under the necessity of rolling our goods. And then it only remains to us to simplify the method of covering the goods and I think we shall attain all that either party will require.

If there is nothing further to be said upon this subject, we will take up topical question

No. 105. "Are horizontal turbines an advantage over vertical turbines with heads below 18 feet?"

The Secretary will read a communication on this subject from Col. SAMUEL WEBBER, who is not able to be with us at this session.

Col. SAMUEL WEBBER. In answer to this question I would say that I believe the height of fall under which horizontal shaft turbines can be run to advantage, depends entirely upon the height to which back water rises on the wheel in time of floods.

The bottom or lower side of the shaft should clear the highest level of back water by at least six inches. Then a proper belt and pulley tank may be sunk, which keeps them dry without touching the shaft so as to cause friction, and if a large pulley is needed this tank may be sunk below tail water level.

The experience of both Mr. JAMES B. FRANCIS and myself show that there is no perceptible difference in efficiency between the horizontal and vertical shafts, and with the horizontal shaft from five to six per cent. of gear friction (so usually estimated) is saved, beside the cost of lubrication of gears and the usual accompaniment of spattered dirt.

In such a case as the upper level at Lowell, where the fall is 13 feet and there is practically no back water, I have no doubt they could be used to advantage, if the work was done on that plan from the beginning, without the obstruction of the old vertical pits. In such a case a six-foot wheel would be the largest admissible size as it would require a twelve-foot case, and with six inches above to insure filling the case and six inches below for draining it, it would take the whole fall.

In laying out the engine room for the New Orleans Exhibition of 1884, we had to sink these tanks for the belt pulleys of all the engines, as the water rose, on digging for the foundations, to within 18 inches of the floor level. For the first ones, we had iron tanks made, but the later ones were built of brick and hydraulic cement and answered the purpose perfectly.

The lower the head the less will be the cost of draft tubes for

horizontal shafts, while the cost of yokes and gears for vertical ones would remain unchanged.

The PRESIDENT. Are there any remarks to be made on this subject? Has Captain HILL any remarks to make?

Capt. JAMES G. HILL. Mr. President, the Secretary kindly invited me, on our journey to the mountains, to speak on the subject of horizontal wheels, as to the advantage or disadvantage over the perpendicular or Boyden type. I have some data at home which might be of value to the Association, but it is some time since I collected it and I am not sufficiently familiar with the subject to impart much of value to the members present. Col. WEBBER has covered the ground in his paper and therein points out the one great saving by the discontinuance of gears. The loss by friction in gears is estimated at 4½ per cent. at least, divided as follows; 1½ per cent. in the driver, 1½ per cent. in the driver gear and 1½ per cent. in the tooth. If intermediate gears are necessary the loss is still larger. It is safe, then, to say that wherever the fall of water is sufficient to permit the use of horizontal wheels there can be no question of their advantage over the old type, and if for no other reason, because of this saving in friction by the discontinuance of gears. But there is a saving beyond that of the loss in friction of gears. I found by actual experience, in keeping the record for several years, that the wear and tear of vertical wheels in the breaking of gears and the renewal of wheel steps alone was a large item of expense. Again, the horizontal wheel and all its important parts are above water and easily examined and if repairs become necessary can be made at a minimum expense.

The PRESIDENT. We will take up topical question

No. 106. "In what respect is a vertical engine advantageous over a horizontal engine for driving cotton mills?"

The subject is open for discussion.

Mr. THOMAS ARMSTRONG. It is claimed by many that the piston, piston rod and cylinder are subjected to less wear from friction on a vertical engine, and that a vertical engine is more compact and therefore requires less floor space than a horizontal engine.

But let us look at some of the disadvantages of this engine. First, it is not so handy to oil; second, it is not so easy for the engineer to see all parts of his engine, which is a very great disadvantage to him; last, we find that in making the ordinary repairs on this engine it is very unhandy to climb up on the top of it to work, and that when there you cannot work to advantage for want of room. This style of engine I should use only when I could not find room for a horizontal engine.

The horizontal engine is handy to oil, the engineer can see all parts of the running works at a single glance, and when making repairs you are on a floor where there is room to do your work in an easy, handy manner.

As to the wearing of the piston or cylinder, I have seen some horizontal engines that have done good work for twenty years, that are not worn enough to hurt the running qualities of the engine.

I have been unable to learn of any saving of coal by the use of the vertical engine, so I am strongly in favor of the horizontal engine in a roomy, well-lighted engine room.

The PRESIDENT. I would say that our Secretary has a few notices to give, after which the meeting will stand adjourned until 8 o'clock this evening, at which time we may expect a very full attendance.

The SECRETARY. Mr. President, I wish to call the attention of the gentlemen to the pamphlets of the Lowell Textile School, some of which are upon this table and some on the one in the centre of the room, which have been brought here by Mr. WILLIAM W. CROSBY, the Principal, and at the special request of our ex-President, Mr. A. G. CUMNOCK, the President of the

Lowell Textile School, who has given so much of his thought and attention to the organization and administration of that institution.

The PRESIDENT. The meeting will stand adjourned until 8 o'clock this evening.

FIFTH SESSION.

THURSDAY EVENING, SEPTEMBER 29, 1898.

The Association met in the parlors of the Crawford House at 8 P. M., President KNIGHT in the chair.

The PRESIDENT. We have with us tonight an ex-president of this Association who has withdrawn from the Association, but has been voted in again today as a new member. He has a paper of very great importance, as many of us think, on the new method of baling cotton — the advantages of the round bale. I have the pleasure of introducing the Hon. WILLIAM C. LOVERING. [Applause.]

SOME ADVANTAGES OF THE CYLINDRICAL LAP BALE.

WILLIAM C. LOVERING, Taunton, Mass.

We have often heard it said that if our ancestors were to reappear upon earth it would seem like a new world to them and their eyes would seek in vain for some familiar object to welcome them back to life. There is one sight, at least, which would greet them if it did not awaken their fondest recollections.

THE OLD COTTON BALE.

They would see beautiful cotton mills equipped with every modern machine, appliance, and device for making wonderful fabrics at an infinitely small cost, but on going through the streets of our manufacturing towns they would see truck loads of the same old misshapen, ragged and dirty cotton bales strewing the roadside with their contents and offering the boys and thieves every opportunity to gather what is known as the city crop. Here at last they would find something in which there had been no change in a hundred years. The truth is there *has* been *no* advance made in the baling of cotton in all these years. There has been some improvement in cultivation and ginning but almost none in baling.

Attempts have been made from time to time to effect a change but beyond compressing the bales in huge compasses for purpose of transportation, cotton comes to our mills today in precisely the same shape as it did 70 years ago. It is exposed to damage by fire, water and dirt and is subject to theft at the compress and in transit. The manufacturers get nothing better than they demand and they demand nothing better than they get, and so the old system prevails.

But at last the manufacturers have roused themselves and demand that their cotton shall be delivered in good order and at net weight. The old bale is doomed and the old methods of marketing cotton must give way to the march of improvement.

Invention has touched with its magic wand every machine and every process in the cotton mill until the product is increased and the cost reduced to a degree far beyond the most sanguine expectation of an Arkwright or a Lowell or even a Mason or a Draper.

Not until comparatively recently has much thought been given to the cotton bale itself. Several bales have appeared in the market, all of which are improvements upon the old style of bale. Each has its friends. Anything that tends to break away from the antiquated hooped bale, that shapeless mass, which by courtesy is called square, is welcomed by the manufacturer. Inventive genius has at last brought forth the perfect cotton bale in the form of the round lap bale. It is practically a condensed breaker lap 36 inches in length and 22 inches in diameter, weighing about 260 pounds. The weight of the lap is about 32 oz. to the running yard.

When the American Cotton Company put out its first bales they were not entirely satisfactory, owing to the fact that the cotton was unduly compressed at the core, and some difficulty was found in unwinding the last part of the bale. This has been entirely and absolutely overcome and the bales now unroll to the last layer without the least hindrance. All who have used the later made bales give their testimony to this. But with the advent of the 36-inch lap bale new advantages have been discovered. In fact, the 36-inch bale was made to meet the wants of the manufacturers. The new bale can be placed directly upon the apron of the lapper, discarding the automatic feeder. There is no need to mix the cotton in the bin previously, as all necessary mixing can be obtained by placing two bales of different grades of cotton on the same apron, and the laps that are made on the breaker lapper can be mixed again by placing three or four laps made from different grades di-

rectly upon the intermediate lapper, and this same mixing process, if desired, can be continued on the finisher or evener lapper. This ensures an absolutely regular mixing such as can not be obtained by simply opening a number of the old style bales and throwing the cotton up into the bins in a hap-hazard way. The laps that come from the breaker lapper will be found to be far more even and regular in weight than those that are made with the automatic feeder. Indeed, it is not unusual to find the ordinary breaker lap made under the old system vary in weight 100 per cent., whereas the laps made directly from the cylindrical lap bale will hardly vary more than 20 per cent. The bale weighing as it does only about 260 pounds is easily handled at all points and especially in the picker room where one man can place the bale directly upon the apron. It will run a long time before replacing.

It will be readily conceded today that in many mills cotton is subjected to unnecessarily brutal treatment in the picker room. The true function of the picker is to remove picker seeds and dirt and to put the staple in a smooth and even lap ready for the card. Any operations beyond this are unnecessary, wasteful and injurious.

Experiments have been made with placing the cylindrical lap bale directly on the intermediate lapper and four of the laps that come from this lapper were placed on the apron of the finisher or evener lapper from which a more even lap was made and the subsequent results obtained were better and evener and more satisfactory every way than were those from the old bale with the breaker lapper, feeder and all. In the one case the cotton was treated by only two beaters, while in the other it was treated by five beaters and an automatic feeder. The table below will show the results at the different stages. It may be said, however, that the cotton was not exactly the same in both cases but was as nearly the same as could be obtained. In the case of the lap bale there was less loss in fly and picker waste than in the old bale. This was due to the fact that in the process of making the cylindrical bale a great deal more of the seed and

dirt was taken out than is the case of making the old style bale. In fact the cotton after it comes from the gin passes through a trunk with dirt pockets and on to a condenser cylinder the same as in a picker. Owing to the less loss in the case of the lap bale the weighings will be found to be slightly heavier.

COMPARATIVE TESTS MADE WITH THE AMERICAN COTTON CO'S LAP BALE AND THE REGULAR BALE, OLD STYLE.

6 sizings 2 yards each of new lap bale on single rigid beater lapper.

29 oz.
28½ "
27½ "
29 "
28½ "
29½ "

Greatest variation 2 oz.

1 Beater.

Breaker lap 6 sizings of old style bale, automatic feed, 1 hinge beater and 2 rigid beaters and doubled 4 on intermediate with one rigid beater.

30½ oz.
28 "
30½ "
30 "
29 "
28 "

Greatest variation 2½ oz.

4 Beaters.

Finisher lap made by running 4 breaker laps on evener lapper. 1 Pin beater.

28 oz.
29 "
29 "
28½ "
29 "
28 "

Greatest variation 1 oz.

1 Beater.

Finisher lap made from running 4 breaker laps on evener lapper. 1 Pin beater.

28½ oz.
28½ "
28 "
27½ "
27 "
27½ "

Greatest variation 1½ oz.

1 Beater.

NEW BALE.

Card Sliver.		*12 Sizings.*	
75	grains.	76	grains.
75½	"	75½	"
75	"	74½	"
77	"	76	"
75½	"	77	"
74½	"	77	"

Greatest variation 2½ grains.

OLD BALE.

Card Sliver.		*12 Sizings.*	
76½	grains.	75	grains.
74½	"	74	"
75	"	73½	"
74	"	74½	"
75	"	73½	"
75½	"	75	"

Greatest variation 3 grains.

First Drawing.

6 into 1.		*12 Sizings.*	
72½	grains.	74	grains.
73	"	73	"
73	"	75	"
74	"	73	"
73½	"	73	"
74	"	74½	"

Greatest variation 2 grains.

First Drawing.

6 into 1.		*12 Sizings.*	
72	grains.	72	grains.
71½	"	72½	"
70½	"	71½	"
70½	"	72½	"
72	"	72	"
71½	"	70½	"

Greatest variation 2 grains.

Second Drawing.

6 into 1.		*12 Sizings.*	
66½	grains.	67½	grains.
68	"	66½	"
67	"	66½	"
67½	"	67	"
67	"	66½	"
67	"	67	"

Greatest variation 1½ grains.

Second Drawing.

6 into 1.		*12 Sizings.*	
66	grains.	65	grains.
65	"	66½	"
64½	"	65	"
65	"	64½	"
65½	"	65	"
64½	"	65½	"

Greatest variation 2 grains.

Third Drawing.

6 into 1.		*12 Sizings.*	
66½	grains.	66	grains.
67	"	65½	"
67	"	66	"
65½	"	65½	"
65½	"	66½	"
65½	"	65½	"

Greatest variation 1½ grains.

Third Drawing.

6 into 1.		*12 Sizings.*	
62	grains.	61½	grains.
63	"	63½	"
61½	"	63	"
62	"	62½	"
63	"	62	"
61½	"	62	"

Greatest variation 2 grains.

Slubber Roving.

12 Sizings.		*12 yards each.*	
100	grains.	99½	grains.
99½	"	99	"
100	"	99	"
99½	"	100	"
99	"	99½	"
99½	"	99	"

Greatest variation 1 grain.

Slubber Roving.

12 Sizings.		*12 yards each.*	
97	grains.	96	grains.
96½	"	96½	"
96	"	96	"
96	"	95½	"
95½	"	96½	"
96½	"	97½	"

Greatest variation 1½ grains.

Fine Speeder.

12 Sizings.		*12 yards each.*	
29	grains.	29	grains.
29	"	28½	"
28	"	28	"
28	"	28½	"
28½	"	29	"
28	"	29	"

Greatest variation 1 grain.

Fine Speeder.

12 Sizings.		*12 yards each.*	
27½	grains.	27½	grains.
28	"	27½	"
26½	"	27	"
27	"	28	"
27½	"	28½	"
27½	"	28½	"

Greatest variation 2 grains.

Yarn spun from New Bale having received only 4 doublings on the lapper with only 2 beaters.		*Yarn spun from Old Bale having received 16 doublings on the lappers with 5 beaters in all.*	
Number.	*Breaking Strain.*	*Number.*	*Breaking Strain.*
23.25	102 lbs.	23.90	80 lbs.
22.22	96 "	25.	75 "
22.72	94 "	23.25	78 "
22.72	100 "	25.	73 "
22.22	98 "	23.25	80 "
22.72	103 "	25.	68 "
Average 22.64.	*Average* 98.63.	*Average* 24.21.	*Average* 79.

While it will be observed that the greatest variation is generally less in the case of a new bale, it will also be observed that the weighings run more nearly uniform in the case of the new bale.

It hardly admits of a doubt that sooner or later the old bale will have to go. Manufacturers seeing the advantages of the lap bale will make haste to adopt it. It is coming to this that the use of the lap bale will save the cost of the breaker lapper with the automatic feeder and the power required to drive it, which in reality is half the power employed in the picker room. It will also save one-half the floor space and about one-third the labor in the picking room. Work hitherto done in the picking rooms of our mills is hereafter to be done practically by cheap negro labor in the South. In other words, our cotton is to be delivered to us in an advanced stage of preparation. In the form of a condensed breaker lap.

The bale is made rapidly and naturally and not by any forced process. There is no danger of heating the press or the cotton by friction, for there is no point of contact where the cotton rubs or is forced or dragged against any metal surface of any kind. The cotton is carried along from the gins by a fan through a trunk to a condensing cylinder in a large receiving chamber by which process it is thorougly aired. From this chamber it is carried always in the same direction by moving surfaces until it is made into the finishing bale. No matter how fast the press runs the cotton is not subjected to any curling, straining or heating process.

A single press will put up more than 30,000 pounds of cotton in ten hours. And as during the ginning season a press is often run 15 or 16 hours it will easily put up 50,000 pounds, or the equivalent of 100 bales weighing 500 pounds each.

Among the many advantages of the lap bale are the following:

Freight. Ultimately a great saving will be made in freight, as a car or vessel will hold more than twice the weight that they will of the old bale.

Storage. A given space in a storehouse will hold more than twice as much cotton in the lap bale as it will in the old bale.

Insurance. Owing to the fact that the air is excluded from the bale it will not burn. If it takes fire it burns the outer layer and goes out, there not being any air within to support combustion. In case of a bale being scorched on the outside a single layer may be unrolled and instantly you have a clean bale that does not even smell of burnt cotton, The cotton can only be released by the continual unrolling of the lap, as it is held together by one lap being pressed against another like a bolt of cloth.

There are no hoops, wires or metal of any kind about the bale, so that there is no danger from fire, as is frequently the case when they are used to hold cotton bales together and in place.

Broken pieces of wire or hoop often find their way into the picker, when fire is almost sure to ensue. This can not happen with the lap bale. The insurance companies recognize all these advantages and are willing to insure cotton in this form at a very much lower rate.

Handling. It requires very much less labor to handle these bales at all points. It is like a man building a stone wall, he can lay much more wall and handle many more tons of stone in a day if he has small stones that he can lift instead of large stones that require machinery or assistance.

Condition. The cotton comes to the mill in neat, compact bales, well covered and protected and distinctly marked, so that the numbers and weights are legible and easily distinguished.

Invoice weights. It is the testimony of treasurers of several New England mills who have used cotton in the cylindrical bale that the weights hold out and in many cases overrun. A recent instance is noted where an invoice of 570 bales invoiced at 267,245 pounds, on being weighed at the mill was found to weigh 267,685 pounds, an overweight of 440 pounds. The actual tare on this lot of cotton was 2278 pounds by weight, or about .85 of one per cent.

Waste. The net waste in using the new 36-inch cylindrical lap bale is reduced to a minimum and reaches a lower point than has ever before been touched in cotton manufacturing. It will be found that the clean condition of the cotton and the less number of operations employed in the picking room makes a great saving of the fibre in all the processes of manufacture. The fibre is not broken or injured by excessive beating, consequently there is less fly, and more full length fibre finds its way into the yarn than by the old method. This insures a stronger and evener yarn.

The cylindrical bale has passed out of the tentative stage and become a commercial and mechanical success. It is a fact accomplished. Hereafter the manufacturer who uses it will have an absolute and indisputable advantage over the one who does not use it, and he who does not use it will find himself outstripped and far behind in the race. It is not the purpose of the American Cotton Company to antagonize any other bale, it looks upon any other system that is an improvement over the old bale as an ally and not as a rival. The field is large and will not be entirely covered for a long time. There is room enough for each and every system. It only remains for the manufacturer after he has made a trial of all the systems to decide which is the most to his advantage. The American Cotton Company does not fear the result.

Profit in cotton manufacturing today is made up of minute economies, and he who disregards them will sooner or later fall out of the race.

If we here in New England expect to maintain our supremacy

against the daily growing competition of the South, we must avail ourselves of every possible advantage and must exact from the South perfect staple in perfect form and in an advanced stage of preparation. The ultimate result will be that the manufacturers will really get cheaper cotton and the planter will get more for his cotton. The saving to both is coming from the elimination of the middlemen, from cutting off of the opportunities to pilfer, and from reduced freight and insurance charges.

The American Cotton Company is thoroughly established with ample capital and is doing a large business. It owns the basic patents on the cylindrical lap bale and also all the patents for making the bale. The company leases the cylindrical presses to the planters or ginners and receives a royalty of 20 cents per hundred weight of cotton baled.

All men of ordinary intelligence can see that the lap bale offers great advantages to the manufacturer, but when it comes to presenting the subject to the New England Cotton Manufacturers' Association, made up of the brightest, most resourceful and ingenious men in the world, to whom a hint only is necessary, I feel that I have assumed too much the role of the essayist and have overtaxed their patience with needless amplifications.

I shall be very glad to answer any questions or enter into any discussion if any one has any inquiries to make.

Mr. JOSEPH M. DUNHAM. What is the cost of baling cotton by this process?

Mr. WILLIAM C. LOVERING. One-quarter of a cent a pound; and that quarter of a cent a pound, let me say, is more than made up to him. The price of cotton, be it understood, is made, not in America, but in Liverpool, and the price of cotton

is generally made deducting the tare in case of foreign shipments here, whereas the price is made on the cotton gross weight. In the case of the old bale six per cent. is allowed on all cotton shipped abroad; in case of the lap bale one per cent. is allowed. The difference is five per cent. Five per cent. on 500 pounds of cotton is 25 pounds of cotton; 25 pounds of cotton at six cents a pound is $1.50. At six cents a pound you are paying 25 cents more for your bale, at any rate, than you are by paying a quarter of a cent a pound for baling by this process, and you can see that in the latter case you are not paying any more for your cotton than you are in the other case, and in fact not quite so much.

Mr. LOUIS SIMPSON. I would like to ask, Mr. President, of the speaker what arrangements there are for sampling these bales.

Mr. WILLIAM C. LOVERING. The bales are put up by the ginner and samples are taken all through the bale. The bale is marked legibly and the sample corresponds with the mark, and by that it is sold. It is possible, however, with a very simple instrument — a saw tooth sampler — to take the sample of that cotton directly from the center to the surface, and it is not necessary to open the bale to do it, either. You can just open a little here [illustrating], put in this saw and turn it that way and draw it out, and you get a sample of that cotton showing the entire bale. It is perfectly well understood that you never obtain a fair sample from the old bale; you almost always take a sample from the outside. They are sampled half a dozen times and you lose the weight every time. This bale is only sampled at one point. You may sample it, if you choose, when you get it at your mill; but it is sampled when made and there are no pickings or robbings or stealings from that bale after it leaves the compress. It may come in a ship or a car direct to you from the ginnery if it be so desired.

Mr. LOUIS SIMPSON. In that case do the American Cotton Company intend to guarantee that it is up to the samples?

Mr. WILLIAM C. LOVERING. They do; and more than that something has been said about a hard core. Some people persist in talking about that, whereas it can be easily seen that there is no hard core, and if you will lay aside any core that you ever find the American Cotton Company will not only pay you a premium for it but they will pay you the full price for it and the freight back to themselves. They will not trouble you with it. There are no cores; the fact is that the center of the bale is wound softer than the outside of the bale now. When they were first put up they were wound just as hard as they could be wound on the centre; that is no longer the case. They are wound softly on the inside and the pressure is put on as it is needed as you come to the surface.

I will say about putting this on the aprons, sometimes you can put an iron right through the bale if you choose to, but I have not found it necessary to do so. In putting it on the apron of the intermediate picker I have found that the bale settled right into a place between the carrier rolls of the apron and occupied that place and staid there until the bale ran almost off to the last layer.

Mr. LOUIS SIMPSON. In respect to using the bales in that way, there is a point that struck me as being fatal, almost, to it. When cotton has been traveling for two months during cold weather the frost gets into the cotton more or less, and you take that cotton at once and put it on the machine, and I should think it would have a tendency to damage the staple. I have found it so in Canada, where, of course, we have it colder than here; but in very many of the mills in upper New York and New Hampshire, during the very severe weather I think they are likely to find the same difficulty, and if so I should think it would be almost fatal in their using the bales.

Mr. WILLIAM C. LOVERING. I will answer that in two ways. In the first place, the frost does not get into this bale. This bale is pressed at a density of 35 pounds to the cubic foot; frost does not get into it as it does into the other bale. Moist-

ure will not get into this bale. The bale that you see before you has been in the rain coming up here. There is not a particle of moisture about it. Now everybody knows that in mixing the cotton there has heretofore been no science whatever. We call it science; we say it is a very scientific thing to mix bales of cotton. We take off the hoops and covers and get boys to throw it up into a bin. They throw it up higgledy-pigglety. The hard pressed cakes of cotton do not air out at all; they have no chance to air. I do not care how long it stays there; sometimes the longer it stays the worse it is. There is no better way to air cotton than to run it into a lap as soon as you can, and then occupy the room of which you will have plenty if you take out your bins and breaker pickers; let that cotton stay there in the open air for days or weeks, just as you please — you will have time — using off the other end all the time.

Mr. LOUIS SIMPSON. I would like to ask you if you have ever tested the difference in a lap that has been kept in that way for some time, between the weight per yard at the outside of the lap and the inside, because I have always found that when you keep a lap over a week's end the outside folds of the lap will weigh less than the inside per yard.

Mr. WILLIAM C. LOVERING. Yes, but the laps are not very dense, at any rate. They are not as dense as the flakes of cotton that you throw up into your bin.

Mr. JOSEPH M. DUNHAM. I would like to ask if the machine that puts up that lap is taking the place, really, of the breaking machine in our mills, and whether it will receive it and leave it in as good condition as when it goes through the breaker? Really, your machine that puts that cotton up takes the place of a breaker?

Mr. WILLIAM C. LOVERING. In a measure it does. The cotton has to go through breakers; it has to go through a picker just the same, because there are seeds in this cotton. There is not a particle of dirt or sand in this cotton, but there are some

seeds in it which the intermediate beater will easily take out. It is fully exposed to the action of the beater.

Mr. JOSEPH M. DUNHAM. So it does not remove all the seeds?

Mr. WILLIAM C. LOVERING. It is not pretended that it does. There is no bale that I know of that does have all the seeds removed, because until you get a perfect gin that removes all the seeds you have got to stick to your picker; you have got to do some picking, some beating; but I think you will all agree with me that most people have done too much beating to cotton. After you have got the seed out and you have got a good even lap to go up to your card, what more do you want?

Mr. JOSEPH M. DUNHAM. That is all you want.

Mr. LOUIS SIMPSON. But I have always understood that the reason why you have openers was to get out the seed; that on the lap machine the beaters were liable to break the seed up. It seemed to me that in order to use the laps in the way you are desiring it would be necessary to alter the beater of the first picker or otherwise you will be having your seed broken up, which is a very bad thing.

Mr. WILLIAM C. LOVERING. You would have the first beater a beater just the same. You would not have a rigid beater in your intermediate picker.

Mr. LOUIS SIMPSON. Do you have only one beater there?

Mr. WILLIAM C. LOVERING. One beater.

Mr. JOSEPH M. DUNHAM. Will your machine put up all kinds of cotton — all staples?

Mr. WILLIAM C. LOVERING. All kinds of cotton; long staple and short.

Mr. JOSEPH M. DUNHAM. With ease?

Mr. WILLIAM C. LOVERING. With the greatest ease.

Mr. CHARLES H. FISH. Mr. LOVERING, will you please tell me to how many pounds you said that bale was compressed?

Mr. WILLIAM C. LOVERING. Thirty-five pounds to the cubic foot.

Mr. CHARLES H. FISH. Do you have in mind to how many pounds the old square bale was compressed?

Mr. WILLIAM C. LOVERING. I think about 21 or 22.

Mr. STEPHEN N. BOURNE. What do the brokers have who sell this cotton? They have this sample.

Mr. WILLIAM C. LOVERING. Now you are coming to a question that I did not come here to discuss at all. I want to speak of the merits of the bale itself and its uses; but that part of the handling of it I am not at liberty to speak about just at present. I have this much to say, however, that it is a pretty well understood fact that there are a great many people getting their living off of handling cotton long before it comes to your mill, and in the future I think there will be less people getting a living from handling cotton. I do not care whether it is this bale or any other bale — any of the improved bales. The tendency is to do away with the old-fashioned compress; the tendency is to do away with this continual re-weighing and re-sampling, which in at least three out of five instances is done for the purpose of robbing the bale and getting paid for weighing it, all adding charges to it, and somebody gets a living out of it. That bale comes directly from the gin in that shape to your mill. It does not go to any compress; it is not carted about, and cotton is not strewn all over the streets of Boston or Lowell, or in the warehouses of the South.

Mr. LOUIS SIMPSON. Just one more question. I do not want to tease you too much, but I am trying to get information.

Mr. WILLIAM C. LOVERING. Oh, I am delighted to answer any questions.

Mr. LOUIS SIMPSON. Of course cotton can be graded at the gin so far as appearances are concerned, but for those of us who use stapled cotton and have to have just the staple we need, what arrangements can you give to insure that we get that? You should know that these men at the gin do not know much about staple, and it seems to me that unless some arrangement can be made so that those of us who require stapled cotton can be insured of getting it, we are going to be in a quandary when your people send us whatever they happen to pick out down South.

Mr. WILLIAM C. LOVERING. There will be just as many honest men left as there are now.

Mr. LOUIS SIMPSON. It is not a question of honesty, it is a question of knowledge.

Mr. WILLIAM C. LOVERING. There is nobody who understands the grade of cotton better than the factor himself, who receives the seed and buys and pays for it. He buys the cotton that is brought in for half price, or three cents a pound, right in the seed — in nine cases in ten that is the way it is done — or the farmer brings it there and has it ginned and baled for his own account, and it is then and there sampled and graded by an expert, and that is the best you can ever get, in my opinion.

Mr. LOUIS SIMPSON. Are you going to keep an expert at the gin houses?

Mr. WILLIAM C. LOVERING. At the gin houses?

Mr. LOUIS SIMPSON. Yes.

Mr. WILLIAM C. LOVERING. Why, yes; they are the best

kind of experts, too. I think there is nobody in the world who knows cotton better than they do.

Mr. LOUIS SIMPSON. I am sorry I do not agree with you on that point, at least as far as staple is concerned.

Mr. WILLIAM C. LOVERING. Well, you have redress always. The American Cotton Company, as far as they are concerned, will guarantee every bale that is put up. Here is the guarantee right on every bale.

Mr. LOUIS SIMPSON. But if I had laid in a big stock of cotton for a certain purpose and do not get it and the time is past when it can be bought down South, what am I going to do?

Mr. WILLIAM C. LOVERING. What assurance have you now?

Mr. LOUIS SIMPSON. Well, simply that I have educated men to know what I want and they see that I get it; but I can not pretent to educate the American Cotton Company because they are a too big concern.

Mr. WILLIAM C. LOVERING. I do not mean to say you are going to get rid of every possible man going around and buying cotton in the South for you, but what I say is that you are going to get rid of a lot of weighers and samplers.

Mr. LOUIS SIMPSON. You miss my point entirely, so that you have not convinced me that I want to deal with you yet. You have convinced me that your form of bale is all right. But this is my point. I go to you and say I want twenty thousand bales of a certain kind of staple; what guarantee am I going to have that I shall get that sample? Of course this is not questioning your responsibility.

Mr. WILLIAM C. LOVERING. You may send your own man, or you may employ any man you choose in the North to do it.

Mr. LOUIS SIMPSON. The cotton may go to Waco or some other cotton market, and it is picked up by buyers just as it turns up. My man there may be able to take only half the bales in any one lot; but he has the opportunity to examine it and get just what he wants. I do not see that he can do this under your system.

Mr. WILLIAM C. LOVERING. You have exactly the same opportunity that you have now.

Mr. LOUIS SIMPSON. I do not see it, unless you are going to arrange for an emporium, so that a man without traveling can go —

Mr. WILLIAM C. LOVERING. How do you pick up your twenty thousand bales now?

Mr. LOUIS SIMPSON. I have buyers in Memphis, buyers in Waco, buyers in Galveston, and so on.

Mr. WILLIAM C. LOVERING. Very well, have the same men there now.

Mr. LOUIS SIMPSON. Yes, but we will not be able to do so, that is if your idea is carried out.

Mr. WILLIAM C. LOVERING. Why not?

Mr. LOUIS SIMPSON. Because the cotton has to be shipped direct from the ginneries.

Mr. WILLIAM C. LOVERING. At the order of these men.

Mr. LOUIS SIMPSON. Yes, but these men cannot be at the ginneries nor can they go down and sample the cotton at the ginneries.

Mr. WILLIAM C. LOVERING. I do not mean to say that every bale of cotton is necessarily shipped directly from the gin to your mill; I say it can be done so. I mean to say it has not

got to go to the compress to be compressed to be shipped to you. But in all probability cotton will be assembled from a district at some emporium or some central point.

Mr. LOUIS SIMPSON. If that be the case matters might be satisfactory; but unless that is done I think there will be trouble.

Mr. WILLIAM C. LOVERING. It must be so. The statement that I made was that the bale can be — I do not mean to say that it always is — shipped direct to you; but I mean to say there is no opportunity to tamper with that bale between the time it leaves the ginnery and it reaches you.

Mr. J. R. MONTGOMERY. I would like to ask if Mr. LOVERING believes that, the cotton coming directly from the gin under a pressure of 35 pounds to the cubic foot and immediately run from that on to the breaker lap, the fibres would lie as softly and as lofty as they would if a hundred bales of cotton had been piled in a pile and lain for a few days or a week or more and allowed to swell and become soft and fluffy?

Mr. WILLIAM C. LOVERING. I firmly believe that, and I think if the gentleman would make a trial of some of the bales himself he would soon find it to be so. I would like to ask him him if he could find anything more fluffy than that? [Holding up a specimen of the cotton from the bale.]

Mr. J. R. MONTGOMERY. I have looked at it and it looks very nice. I asked for information.

Mr. WILLIAM C. LOVERING. [Giving sample of cotton to Mr. MONTGOMERY.] How is that for fluff?

Mr. J. R. MONTGOMERY. Very nice.

THE EARLY HISTORY OF THE POWER LOOM.

ALFRED M. GOODALE, Boston, Mass.

On June 21st, 1858, Mr. F. B. CROWNINSMIELD, Treasurer of the Merrimac Manufacturing Company, Mr. THOMAS CARY, President, Proprietors of Locks & Canals, and JAMES B. FRANCIS, Agent, Proprietors of Locks & Canals, wrote the Hon. NATHAN APPLETON asking him if he would give, for the benefit of the present generation, some facts in connection with the early introduction of the power loom, and the early history of the city of Lowell that were known only to himself, owing to his early co-operation with Messrs. FRANCIS C. LOWELL, PATRICK T. JACKSON and KIRK BOOTT. Mr. APPLETON accepted, and described the early introduction of the power loom in this country as follows:

"My connection with the cotton manufacture takes date from the year 1811, when I met my friend Mr. FRANCIS C. LOWELL, at Edinburgh, where he had been passing some time with his family. We had frequent conversations on the subject of the cotton manufacture, and he informed me that he had determined, before his return to America, to visit Manchester, for the purpose of obtaining all possible information on the subject, with a view to the introduction of the improved manufacture in the United States. I urged him to do so and promised him my co-operation. He returned in 1813. He and Mr. PATRICK T. JACKSON, came to me one day on the Boston exchange, and stated that they had determined to establish a cotton manufactory, that they had purchased a water power in Waltham, (Bemis's paper mill) and that they had obtained an act of in-

corporation, and Mr. JACKSON had agreed to give up all other business and take the management of the concern.

"The capital authorized by the charter was four hundred thousand dollars, but it was only intended to raise one hundred thousand, until the experiment should be fairly tried. Of this sum Mr. LOWELL and Mr. JACKSON, with his brothers, subscribed the greater part. They proposed to me that I should take ten thousand of this subscription. I told them, that theoretically I thought the business ought to succeed, but all which I had seen of its practical operation was unfavorable; I however was willing to take five thousand dollars of the stock, in order to see the experiment fairly tried, as I knew it would be under the management of Mr. JACKSON; and I should make no complaint under these circumstances, if it proved a total loss. My proposition was agreed to, and this was the commencement of my interest in the cotton manufacture.

"On the organization of the company I was chosen one of the directors, and by constant communication with Messrs. LOWELL and JACKSON, was familiar with the progress of the concern.

"The first measure was to secure the services of PAUL MOODY of Amesbury, whose skill as a mechanic was well known, and whose success fully justified the choice.

"The power loom was at this time being introduced in England, but its construction was kept very secret, and after many failures, public opinion was not favorable to its success. Mr. Lowell had obtained all the information which was practicable about it, and was determined to perfect it himself. He was for some months experimenting at a store in Broad street employing a man to turn a crank. It was not until the new building at Waltham was completed, and other machinery was running, that the first loom was ready for trial. Many little matters were to be overcome or adjusted before it would work perfectly. Mr. LOWELL said to me that he did not wish me to see it until it was complete, of which he would give me notice. At length the time arrived. He invited me to go out with him and see

the loom operate. I well recollect the state of admiration and satisfaction with which we sat by the hour, watching the beautiful movement of this new and wonderful machine, destined as it evidently was, to change the character of all textile industry. This was in the autumn of 1814.

"Mr. LOWELL'S loom was different in several particulars from the English loom, which was afterwards made public. The principal movement was by a cam, revolving with an eccentric motion, which has since given place to the crank motion, now universally used; some other minor improvements have since been introduced, mostly tending to give it increased speed.

"The introduction of the power loom made several other changes necessary in the process of weaving. The first was in the dressing, for which Mr. HORROCKS of Stockport, had a patent, and of which Mr. LOWELL obtained a drawing. On putting it in operation, an essential improvement was made, by which its efficiency was more than doubled. This Waltham dressing machine continues in use, with little changes from that time. The stop motion, for winding on the beams for dressing, was original with this company.

"The greatest improvement was in the double speeder. The original fly-frame introduced in England, was without any fixed principle for regulating the changing movements necessary in the process of filling a spool. Mr. LOWELL undertook to make the numerous mathematical calculations necessary to give accuracy to these complicated movements, which occupied him constantly for more than a week. Mr. MOODY carried them into effect by constructing the machinery in conformity. Several trials at law were made under this patent, involving with other questions, one, whether a mathematical calculation could be the subject of a patent. The last great improvements consisted in a more slack spinning on throstle spindles, and the spinning of filling directly on the cops, without the process of winding.

"From the first starting of the first power loom, there was no hesitation or doubt about the success of this manufacture. The full capital of four hundred thousand dollars was soon filled up

and expended. An addition of two hundred thousand was afterwards made, by the purchase of the place below in Watertown.

"After the peace in 1815, I formed a new co-partnership with Mr. BENJAMIN C. WARD. I put in the capital for the purpose of importing British goods, with the understanding that I was not to perform any part of the labor of carrying on the business. I was content with a moderate fortune, but not willing to disconnect myself entirely from business. An accidental circumstance occasioned the continuance of this co-partnership until 1830.

"At the time when the Waltham company first began to produce cloth there was but one place in Boston at which domestic goods were sold. This was at a shop in Cornhill kept by Mr. ISAAC BOWERS, or rather by Mrs. BOWERS. As there was at this time only one loom in operation, the quantity accumulating was not very great. However, Mr. LOWELL said to me one day that there was one difficulty which he had not apprehended, the goods would not sell. We went together to see Mrs. BOWERS. She said everybody praised the goods, and no objection was made to the price, but still they made no sales. I told Mr. LOWELL, the next time they sent a parcel of the goods to town, to send them to the store of B. C. Ward & Co., and I would see what could be done. The article first made at Waltham, was precisely the article of which a large portion of the manufacture of the country has continued to consist; a heavy sheeting of No. 14 yarn, 37 inches wide, 44 picks to the inch, and weighing something less than three yards to the pound.

"That it was so well suited to the public demand, was a matter of accident. At that time it was supposed no quantity of cottons could be sold without being bleached; and the idea was to imitate the yard wide goods of India, with which the country was then largely supplied. Mr. LOWELL informed me that he would be satisfied with twenty-five cents a yard for the goods, although the nominal price was higher. I soon found a purchaser in Mr. FORSAITH, an auctioneer, who sold them at auction at once, at something over thirty cents. We continued to sell

them at auction with little variation of the price. This circumstance led to B. C. Ward & Co. becoming permanently the selling agents. In the first instance I found an interesting and agreeable occupation in paying attention to the sales, and made up the first account with a charge of one per cent. commission, not as an adequate merchantile commission, but satisfactory under the circumstances. This rate of commission was continued, and finally became the established rate, under the great increase of the manufacture. Thus, what was at the commencement rather unreasonably low, became when the amount of annual sale, concentrated in single houses amounted to millions of dollars, a desirable and profitable business.

"Under the influence of the war of 1812, the manufacture of cotton had greatly increased, especially in Rhode Island, but in a very important manner. The effect of the peace of 1815 was ruinous to these manufacturers.

"In 1816 a new tariff was to be made. The Rhode Island manufacturers were clamorous for a very high specific duty. Mr. LOWELL was at Washington, for a considerable time, during the session of Congress. His views on the tariff were much more moderate, and he finally brought Mr. LOWNDES and Mr. CALHOUN, to support the minimum of 6¼ cents the square yard, which was finally carried.

"In June, 1816, Mr. LOWELL invited me to accompany him in making a visit to Rhode Island, with a view of seeing the actual state of the manufacture. I was very happy to accept his proposition. At this time the success of the power loom at Waltham was no longer a matter of speculation or opinion; it was a settled fact. We proceeded to Pawtucket. We called on Mr. WILKINSON, the maker of machinery. He took us in his establishment — a large one; all was silent, not a wheel in motion, not a man to be seen. He informed us that there was not a spindle running in Pawtucket, except a few in SLATER'S old mill, making yarns. All was dead and still. In reply to questions from Mr. LOWELL, he stated, that during the war the profits of manufacturing were so great, that the inquiry

was never made whether any improvement could be made in machinery, but how soon it could be turned out. We saw several manufacturers; they were all sad and despairing. Mr. LOWELL endeavored to assure them that the introduction of the power loom would put a new face upon the manufacture. They were incredulous; — it might be so, but they were not disposed to believe it. We proceeded to Providence, and returned by way of Taunton. We saw, at the factory of Mr. SHEPHERD, an attempt to establish a vertical power loom, which did not promise success.

"By degrees, the manufacturers woke up to the fact that the power loom was an instrument which changed the whole character of the manufacture; and that by adopting the other improvements which had been made in machinery, the tariff of 1816 was sufficiently protective.

"Mr. LOWELL adopted an entirely new arrangement, in order to save labor, in passing from one process to another; and he is unquestionably entitled to the credit of being the first person who arranged all the processes for the conversion of cotton into cloth, within the walls of the same building. It is remarkable how few changes have since been made from the arrangements established by him, in the first mill built at Waltham. It is also remarkable, how accurate were his calculations, as to the expense at which goods could be made. He used to say that the only circumstance which made him distrust his own calculations, was, that he could bring them to no other result but one which was too favorable to be credible. His calculations, however, did not lead him so far as to imagine that the same goods which were then selling at thirty cents a yard, would ever be sold at six cents, and without a loss to the manufacturer, as has since been done in 1843, when cotton was about five or six cents a pound. His care was especially devoted to arrangements for the moral character of the operatives employed. He died in 1817, at the early age of 42, beloved and respected by all who knew him. He is entitled to the credit of having introduced the new system in the cotton manufacture, under which it has

grown up so rapidly. For, although Messrs. JACKSON and MOODY were men of unsurpassed talent and energy in their way, it was Mr. LOWELL who was the informing soul, which gave direction and form to the whole proceeding."

The accuracy of the above account has never been questioned. Waltham people, and particularly those connected with the mill, whose beginning has been so graphically stated by Mr. APPLETON, have been fond of claiming that here was the first mill in the country that made cotton into cloth by mechanical processes, including the power loom, under one roof. Knowing as I did, the custom in England, of having weaving and spinning in separate establishments, I have even gone so far as to state that this claim might be made broader, so as to include not only this country, but the world — and these claims have never been criticised or questioned until the Hon. ROBERT S. RANTOUL of Salem, delivered his address at the two hundred and fiftieth anniversary of the town of Beverly.

Mr. RANTOUL'S address is most interesting, and should be read by all interested in the early history of the cotton manufacture, and I want to quote liberally from the same.

"The biographies of SAMUEL SLATER show that he first arrived in New York in November, 1789. Of course his establishing of cotton manufactures at Pawtucket must have been some months later than that. It is claimed that he established them there in October, 1790. The exact date at which his machinery began to work I find to be December, 21st, 1790, and I think no products of his mill were sold before the year 1791.

"While I have not the slightest disposition to disparage the man or the glorious work he did, it is easy, and I think it is worth while to show, from contemporaneous proof, that when SLATER first set foot in Pawtucket, the shopkeepers of Salem and Beverly were retailing over their counters the finished products of the first cotton mill in America.

"I find at the registry of deeds that, on the 18th day of August, 1788, for the consideration of eighty pounds and five shillings lawful money, JAMES BATCHELDER, Esq., and HANNAH

his wife, conveyed to JOHN CABOT, merchant, and JOSIAH FISHER, physician, all being of Beverly, certain premises comprising five or six acres of land lying on 'the road from Mr. OLIVER'S meeting house to Beverly Ferry.' Ten years later this estate, with certain buildings thereon standing, was deeded by CABOT and FISHER to SAMUEL BLANCHARD, and through BLANCHARD and JOHONNOT it came in time into the hands of Hon. ROBERT C. WINTHROP then of Wenham, who conveyed it in 1833 to BENJAMIN LUDDEN of Beverly. SIMEON BAKER'S tavern and well, and the old Ipswich road, figure as landmarks in the deeds of conveyance. Mr. OLIVER'S meeting house was, of course, the second parish meeting house, where Mayor OLIVER'S father officiated at the time of his death. The old Baker tavern will be recognized at once as the scene of CHOATE'S first plea, and the well is famous for having relieved the thirst of WASHINGTON.

"On this lot, at some time after August, 1788, the Messrs. CABOT, FISHER and their associates had erected a three-story brick building for the manufacture of cotton fabrics. The mill is not now standing. It is well remembered by living persons, and I have been enabled with their help to procure a representation of it which I shall take pleasure in depositing with your society. The late Dr. PEABODY of Cambridge remembered it and says, in a sketch of Dr. FISHER, that it was built in 1788. WILLIAM ENDICOTT, the oldest resident of Beverly, remembers it and saw it burn. ABRAM CALDWELL, born near it, and now the oldest resident of Ipswich, writes me a letter minutely describing it. Mrs. NANCY SHELDON, the brothers BRACKETT and WILLIAM LORD, WILLIAM GRANT and other living witnesses attended school in it after the war of 1812-15, when it was last used for manufacturing purposes. The Salem Gazette of Oct. 14, 1828 says: 'The brick factory, with the barn and shed attached to the Baker tavern in Beverly, was burnt down and the tavern was on fire when the Eastern stage came through Beverly last evening.' And the Essex Register of the 16th adds: 'The fire first started from the chimney of the tavern just before dark

during a violent gale, and consumed the brick building near by, formerly used as a cotton factory.' A brick meeting house was erected in 1829 at Beverly Farms, and the venerable Deacon HASKELL was one of a party of young men who at that time visited the ruins of the cotton mill at upper Beverly, where they cleaned the bricks and removed them to the Farms to be used in building the village meeting house.

"Before the purchase of this ample property the Beverly adventurers had petitioned the legislature, June, 1788, for an act of incorporation. The petition sets forth so clearly the whole scope and nature of their enterprise, and is so influentially endorsed, that I ask your permission to read it. The petitioners represent that the Commonwealth has reached a point of population and agriculture at which it becomes necessary to establish manufactures. That no kind of manufacture appears more practicable at present or more useful than that of cotton. The principal part of the labor is performed by machinery. Many of the machines are applicable to the manufacture of silk, hemp, flax and wool. It will afford enployment to a great number of women and children, many of whom will otherwise be useless, if not a burden to society. Induced by some of these considerations they have endeavored to ascertain by actual experiment on a small scale the probability of success in attempting this manufacture. They find it in their power to fabricate any kind of cotton or linen goods equal in quality to any made in Europe and much superior to those usually imported. Cotton may be procured here as cheap or cheaper than in Europe. Linen yarn, machinery and labor in general will be on an average about 50 per cent. higher. They are of the opinion that although the balance cannot be greatly in favor of the business yet it will afford such profit as to support itself, excepting the extraordinary expense attending its introduction. This expense they conceive to be really lost by the first undertakers, and, if the art be valuable, gained by the community. They therefore conceive that it is necessary to the establishment of such manufacture that the legislature should grant some peculiar favors to the

first adventurers; otherwise to them even success will be attended with a considerable loss, a sacrifice which, they presume, the community cannot reasonably expect. They pray the court to take the premises into their consideration, and to grant them a charter with such immunities and favors as they in their wisdom shall think necessary to counterbalance the disadvantages and expenses peculiar to the introduction of this manufacture. The signers were JOHN CABOT, GEORGE CABOT, DEBORAH CABOT, ANDREW CABOT, MOSES BROWN, NATHAN DANE, JOSHUA FISHER, THOMAS SOMERS, ISRAEL THORNDIKE, JAMES LEONARD, HENRY HIGGINSON and ISAAC CHAPMAN.

"This petition was committed June 6th, and June 7th was referred to a sitting of the General Court, which began in January 1789. In February, 1789, the adventurers not only procured a charter with leave to hold real estate amounting to ten thousand pounds, and personal estate amounting to eighty thousand pounds, but they also received an elaborate endorsement of their enterprise coupled with a grant of aid in the form of a resolve for encouraging cotton manufactory at Beverly, so that there was at Beverly in February, 1789 — SLATER had not then set foot in America — something which the legislature of Massachusetts described as a cotton manufactory and thought worthy of encouragement. . . .

"The Salem Mercury for April 22, 1788, made this announcement: 'Several public-spirited gentlemen in Beverly have procured a complete set of machines for carding and spinning cotton, with which an experiment was made a few days ago, answering the warmest wishes of the proprietors. The spinning jenny spins 60 threads at a time, and with the carding machine 40 pounds of cotton can be well carded in a day — the warping machine and the other tools and machinery, part of which go by water, are all complete — perform their various operations to great advantage and promise much benefit to the public and emolument to the patriotic adventurers.' And on May 6, 1788, the Salem Mercury reported 'The artists who introduced into Beverly the machines for carding and spinning cotton are Mr.

LEONARD and Mr. SOMERS, who were regularly bred to the making and finishing of velvets, corduroys, Jeans, fustians, denims, Marseilles quilting, dimity, muslins, etc. With such talents they supposed that the risk and expense of coming to this country would be amply recompensed by the encouragement such valuable manufacturers deserve. But they made various applications with no other effect than loss of time and money. Such difficulties, co-operating with the want of energy and system in our governments, reducing them to the disagreeable necessity of resolving to leave a country so unpromising to manufactures, when the Hon. GEORGE CABOT generously patronized them, and influenced a number of gentlemen in Beverly to associate for the purpose of establishing these much wanted industries. These gentlemen merit the thanks of their fellow-citizens.'

"On January 6, 1789, the Salem Mercury mentions a promising cotton manufactory in Beverly. It is plain that the projectors, since securing a location the August before, had lost no time. They erected on it a plain three-story building of brick, measuring about 60 by 25 feet, with a pitched shingled roof and a deep basement, in one end of which moved a heavy pair of horses to furnish rotary power. The late JOSHUA HERRICK of Maine, afterwards a member of Congress, when a boy, used to drive them. In the north-westerly corner of the lot stood a small wooden dye house, which either disappeared in the fire or has been converted into a dwelling. The brick mill stood 70 feet behind and parallel with the line of the tavern yard. Between the factory and Ipswich road was the famous well of water, with well sweep and curb, from which the neighboring inn supplied itself and WASHINGTON is recorded as drinking. Beverly, by vote of the town, excused the foreman from the payment of a poll-tax for 1788, and in October of that year, in another vote, spoke of the 'Cotton Manufactory that has lately been set up in this town.' Apprentices were received as early as June, 1789, and in 1790 the Beverly factory sent out a mechanic to introduce its machinery in Connecticut. But

before the close of the eventful year of 1789, the birth year of the United States Government, an incident occured of most fortunate omen for the infant enterprise. On the 30th day of October in that year, WASHINGTON took breakfast with GEORGE CABOT at his house in Beverly, and afterwards rode out to visit the cotton mill on his way to Portsmouth. Nothing could have given more encouragement and publicity to the patriotic experiment.

"WASHINGTON had passed the night in Salem. On Friday morning, in compliance with the universal wish of the people that the most majestic figure of the time might be seen once more on horseback, he had mounted the white charger, at the steps of the Ward mansion, in the street which at that time took his name, and proceeded to Beverly. He dismounted first to inspect the draw of the just completed bridge of which his friend and long time correspondent, GEORGE CABOT, has been the chief promoter, and again for breakfast at the CABOT mansion. Here HENRY CABOT, the little son of the host, the grandfather of his namesake, Senator LODGE, who tells the story, hid himself under the mahogany and watched with breathless scrutiny every look and gesture of the Father of his Country. Breakfast over, WASHINGTON was again in the saddle and only surrendered the charger to his colored groom on leaving the cotton mill.

"At the mill WASHINGTON was attended by a bevy of young women, the attendants at the mill being generously reinforced for the occasion by hosts of friends all eager to demonstrate the processes and exhibit the machines with an unforgotten sense of delight such as no other moment of their lives was ever able to afford them. Having slaked his thirst at the well, on retiring, the illustrious guest resumed his traveling carriage for Newburyport and Portsmouth.

"But before night WASHINGTON had made the daily entry in his journal. It was in these words: 'Friday, October 30th, a little after eight o'clock, I set out for Newburyport and in less than two miles crossed the bridge between Salem and Beverly,

which makes a handsome appearance.' [He then discusses the bridge at some length and resumes.] 'After passing Beverly two miles we come to the cotton manufactory which seems to be carrying on with spirit by the CABOTS [principally]. In this manufactory they have new invented carding and spinning machines. One of the first supplies the work, and four of the latter, one of which spins 84 threads at one time by one person. The cotton is prepared for these machines by being drawn lightly to a thread on a common wheel. There is also a machine for doubling and twisting the threads for particular cloths; this also does many at a time. For winding the cotton from the spindles and preparing it for the warp there is a reel which expedites the work greatly. A number of looms (15 or 16) were at work with spring shuttles, which do more than double work. In short the whole seems perfect and the cotton stuffs which they turn out excellent of their kind — warp and filling both of cotton.'

"FELT, the infallible annalist of Salem, says that in 1790 the wear of the Beverly corduroys had become very common; whilst the biographies of SLATER make it pretty certain that he had produced no textile fabrics ready for the market before 1791. But finally, we have in addition to all this an explicit declaration from the leading spirit in the Pawtucket Enterprise to the effect that Beverly was ahead of him.

"MOSES BROWN, an eminent Quaker capitalist of Providence, was from the outset the head and front of SLATER'S undertakings. He invited him from New York, he established him at Pawtucket, and he at once began a correspondence with his namesake, MOSES BROWN, of the Beverly adventurers, craving sympathy in the discouragements which tried his Quaker equanimity, and especially asking co-operation in petitioning Congress and the States for aid and legislation. In an early letter of this kind, Mr. BROWN writes: 'I have for some time thought of addressing the Beverly manufacturers on the subject of an application to Congress for some encouragement to the cotton manufacturers, by an additional duty on the cotton goods im-

ported and applying such duty as a bounty, partly for raising and saving cotton in the Southern States, of a quality and cleanness suitable to be wrought by machines, and partly as a bounty on cotton goods of the kind manufactured in the United States, and it is the desire of those concerned this way that you, *being the first and largest*, would take the lead, and devise such plans as may be most eligible.'

"No son of Beverly, jealous of her ancient fame, and anxious at once to claim all that is her due, and to claim nothing which does not belong to her, need hesitate to assert, anywhere and at all times that the first cotton mill of America was the Beverly Cotton Mill."

After this address had been published, certain correspondence followed between Mr. RANTOUL and Mr. ARTHUR T. LYMAN, the President of the Boston Manufacturing Company, and in the course of the same Mr. RANTOUL further said:

"Nobody can define cotton mill so as to exclude the establishment we had working in Beverly in 1789. It took in raw cotton, converted it under one roof into a salable product made wholly of cotton, not a single fabric, but a considerable variety of fabrics, and it used in so doing an improved shuttle of some sort, which did twice the work of the old hand shuttle. If this is a cotton mill, we had the first one in the country. No fair definition of a cotton mill can exclude us."

"The fact that the shuttle and the loom were not as good as you introduced later at Waltham does not militate against my claim. We did not have your power loom. We did not have so good a power loom, but if we had what CARTWRIGHT and his contemporaries called a 'power loom,' why rule us out of court by defining power loom in a way to exclude CARTWRIGHT and include Waltham."

At once arose the question, what was a power loom, and in getting at the bottom of this subject it has been necessary to commence at the very beginning, and make a thorough study of the old English patents, and of the histories of early cotton manufacture that were available, and it may be interesting to

the members of the New England Cotton Manufacturers' Association to go with me through these early patents and examine the designs and inventions therein contained.

I have gone all over the English patents as contained in the Boston Public Library from their commencement October 3rd, 1687, to July 14th, 1813, and give herewith a resume of the patents granted.

October 3rd, 1687, No. 257 is the first time the word "engine" is used, and is as follows: "The engine by the help of which the weaver may perform the whole work of weaving without the help of the draught boy."

October 22nd, 1760, No. 753 speaks of an invention that can be applied to the old Dutch loom or engine loom. The new Dutch or swivel loom.

October 20th, 1774, No. 1083 describes a loom for weaving which is stated may be worked by men, horses, cattle, fire, air or water.

April 4th, 1785, No. 1470 has a vertical power loom of EDMUND CARTWRIGHT, and he states it is worked by mechanical force.

October 30th, 1786, No. 1565 is EDMUND CARTWRIGHT'S, and this weaving machine or loom, the frame is stated to be of the ordinary hand loom construction. It further states the machine is thrown into or out of gear with the driving power by means of the lever working on a centre near the floor. The lever actuates a socket driving on the driving shaft. On the sockets are two arms, which are caught by two stops on the driving wheel.

August 1st, 1787, No. 1616 is another of CARTWRIGHT'S, and has a stop motion when the shuttle fails to enter the box.

August 3rd, 1789, No. 1696. For weaving is another of CARTWRIGHT'S application, as is November 12th, 1788, No. 1676. "The lay is pushed forward by pulleys revolving in arms fastened by a square piece of wood fixed on the driving shaft. The lay is brought back by wood springs."

May 11, 1791, No. 1804, "will work either by hand lathe,

steam engine, or by water machinery. The lathe is worked by a crank."

March 15, 1792, No. 1860 says: "My first improvement of the weaving engine or machine is the construction of it so as to render it capable of being worked by or connected to either of those engines or machines moving by the power of water, steam, fire or air, or by the power of a horse or by any other given power, and this I do by causing the primary wheel to my new inventive engine or machine to be connected to one of those engines moved by either of the above named powers." The balance of the description gives no idea whatever of the mechanism used, and what is described is certainly very different from the power loom as it was first known in this country.

May 15th, 1792, No. 1876 is the last of four applications of EDMUND CARTWRIGHT, but is not specific.

September 28th, 1795, No. 2067 speaks of various important improvements of double beating and graduating engine or machine loom for weaving by the powers of steam or water.

June 28th, 1796, No. 2122 refers to a power loom; and also speaks of a stop motion when the shuttle fails to enter the box.

February 19th, 1800, No. 2377 speaks of cops being used both for warp and filling; first filling the cops with wet and then pressed into mould. It may be added that if the cops from the mould do not appear sufficiently dry, gentle application of heat by a stove or other contrivance may be made use of to remedy the defect.

April 14th, 1803, No. 698, mention is made of a power loom, and a motion is described for stopping a loom when the shuttle does not enter the boxes.

April 20, 1803, No. 2699 relates to improvements to a loom for weaving of cotton and other goods by steam and water.

August 3, 1803, No. 2728. The invention relates to the taking-up motion to be applied to hand looms. It seems certainly fair to infer that if power looms were at this date in use to any considerable extent, no attention would be paid to improving

the hand looms. It might be applied to the numerous hand looms in existence.

August 9, 1805, No. 2876 describes a new improved machine or loom for weaving cotton and other goods by power. It says one method of working the lay is by means of a pin set eccentrically on the driving wheel. The pin is connected to the lay by arms. Another method is by eccentric working in the clip or lever working up on the centre, which is connected by a rod to the lay as in the hand loom. The lay was always worked by hand. This very blind description certainly shows another method of moving a lay.

December 4, 1806, No. 2992 speaks of cords to the handle which the weaver holds in his hand, and with which he is enabled to pick both shuttles at the same time.

April 11, 1807, No. 3031 specifically states that the shuttle is worked by hand.

March 23, 1807, No. 3023 describes a vertical loom and says: "Let it now be supposed that the first access shall be set in motion by hand, or by any other power or force."

June 16, 1807, No. 3054 describes a box loom, but from the description given it is clearly a hand loom, as follows: "Motion is communicated to the boxes by cords attached to the handle, and boxes at the side of the lay are lifted by means of the cord attached to the lever; working on the centre to the other end of the lever is another cord worked by the weaver."

January 15, 1810, No. 3291 is to regulate the tension of the warp in power looms, but no description is given that would imply a power loom as we understand it today.

July 14th, 1813, No. 3717 is termed a steam apparatus called the power loom, the expense of the erecting of which with the various apparatus is from £20,000 to £25,000. Again, in 1813, February 20th, No. 3648 refers to an invention of a method of working weaving looms by machinery. This is very involved, and does not seem practical.

Two of these patents, one of CARTWRIGHT'S and one of CLARK'S, are so interesting that I reproduce them in full, together with the drawings of the same.

No. 1565.

Now know ye, that I, the said EDMUND CARTWRIGHT in persuance of and in compliance with the said proviso in the said recital Royal Letters Patent contained, do by this present instrument declare that the nature of my said weaving machine and the manner in which the same is to be performed is described and ascertained in the plan herewith annexed, and which is explained and referred to in the letters, figures and words following, that is to say:

Letter *A* is a wheel revolving upon a round part of the axis. Note, when the socket is pressed to the wheel the arms *a a* catch upon the studs *b b* and the wheel carries the socket, and consequently the machine along with it; when the socket is plucked away, it and the wheel being no longer connected, the wheel revolves and the socket and machine stand still, as in Fig. 2. *C* is a lever turning upon a center at *c*, which when carried from the wheel disunites the wheel and the socket. Note, when the operator wants to stop the machine, he presses the rod 8 and vice versa when he wants to put it in motion. *D* is a lever lying against a notch or segment of the pulley *E* and turning upon the center *d*. *F* is a pulley which together with the lever *D* is fixed in the bottom of the lathe or frame which carries the reed. Note, the lever *D* (so long as there are no broken threads) stands at right angles with the lathe, and in this position passes as the lathe is thrown to on the outside of the lever *C*, as in Fig. 1. Round the pulley are two strings, each revolving the same way. These strings, being carried along the bottom of the lathe till they come out under or beyond the extremities of the reed, are connected to the movable frame *F F F F* as in Fig. 3.

F is the movable frame having the part adjoining to the lathe supported by loops on two rods fastened to the lathe, and the outer part supported by loops on two rods *e e f f* fastened at each end upon a board lying under the warp, and on which rod it glides. It vibrates with the lathes, and at every vibration passes under hooks, which are severally suspended upon each thread and which are strung upon the rod *g g*. Note, if a thread breaks, the hook which was suspended upon it drops down upon the board lying under it, and catches the frame which is made bevel edged for the purpose of slipping under the nose of the hook; the lathe going to while the frame is held by the hook. The pulley *E* is turned round, and an oblique direction given to the lever *D*; see Fig 4. It this direction it strikes, or is wedged against the inside of the lever *C*, which is thus forced from the wheel *A*; and

as the lever *C* carried the socket *B* along with it, the socket and the wheel are disunited and the machine stopped (see Fig 2). Note, the pulley is brought back to the place by a coiled spring like the main spring of a watch, in the inside of it. It may also be brought to its place by a string passing around it and coming to a convenient part of the lathe for the operator to lay hold of. The coiled spring serves also to keep the movable frame steady to its place. *G* is a small staple in the shuttle, swinging a wire *h h*. The velocity of the thread passing under it prevents the staple from dropping below the bottom of the shuttle. If the thread breaks the staple drops, and in its passage catches the hook *H*, which projects a little above the floor of the fly or board on which the shuttle runs. *H* is a hook connected by a wire to the lever *D*. The hook swings upon a center at *i*. When caught by the dropping of the staple *G*, it gives an oblique direction to the lever *D* and consequently stops the machine.

I is the principal axis, at one end of which is the worm *k*, working upon the wheel *l*, and giving motion to the axis *m m*, at each end of which axis is a worm, each worm giving motion respectively to the two wheels *K* and *L*. Note, the wheel *l* works upon a round part of the axis *m m* which it puts in motion, by being connected with the movable square socket *M*. When the square socket is drawn off, which it may be by the lever *N*, the axis *m m* stands still consequently the cloth does not wind up. This will be necessary should the shuttle at any time pass without carrying any woof along with it. *K* is a wheel fast upon the axis of the cylinder *O O*, which by binding in its revolution against the cylinders *p p* and *q q* either one or both of them, takes up the cloth as it weaves. *L* is a wheel connected with the axis of the cylinder *r r* which lets off the yarn in the same manner as the wheel *K* takes up the cloth. Note, the wheel *L* revolves upon a round part of the cylinder's axis, and is kept to its place by the endless screw *a*, and working upon the wheel, which is fast upon the square part of the same axis.

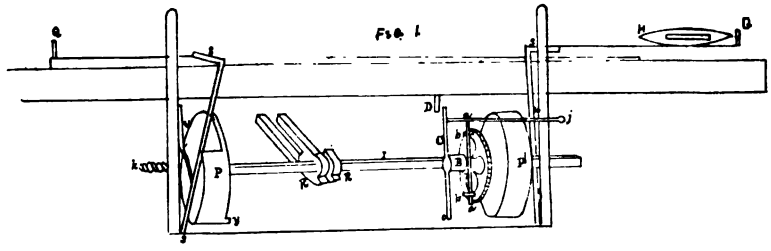
By means of the endless screw, the yarn is made slacker or tighter, as occasion may require. *M* is a square socket, connecting the wheel *l* with the axis *m m*. Note, by varying the number of teeth upon the wheel *l*, as also by varying the number of teeth upon the wheels *K* and *L*, the cylinders take up and let off faster or slower, and consequently more or fewer threads may be put into any given space according to the discretion of the operator; hence the work is made invariably uniform. *N N* are the wheels which force back the lathes. *O O* the

springs which throw it to. *P P* are the wheels which force up the rods *S S* (see Fig. 1). To each rod is joined a wire, the extremity of which lies against the back of the corresponding picker. When the rods are alternately set at liberty from the wheel *P P*, the springs *u u* strike and the shuttle is thrown. Note, the wheels *P P* have that part immediately following the place where the rods strike off formed spirally like a screw, for the purpose of drawing up the rods to their places again. *Q Q* are the pickers gliding in grooves, and having springs *V V* (see Fig. 8) are gradually pressing as the picker recedes from the shuttle against the sides of the frame in which they slide, and thereby preventing the shuttle from rebounding.

R R are the wheels or tappits that work the treadles that draw down the gelds or harness, and open the shed (see Fig. 1). S are the temples closed by the springs *w w*. See Fig. 9. *T* are the temples opened by the treadles *x x* which are pressed down by the cogs *y y* upon the wheels *P P*. Note, when the temples are open, the space from the points *z z* is less than when the temples are closed. Note, also, that when the cloth is set at liberty from the temples, it contracts. In proportion as it contracts, the temples must be made to open more or less, so as to keep the points *z z* in contact with the selvage of the cloth, that when the temples close the cloth may be stretched out again to its proper dimensions. *U* is trough for containing the composition for dressing the work, Fig. 6. *N* is a cylindrical brush revolving within the trough *U*, and feeding the cylindrical brush. *W W* is a cylindrical brush conveying the dressing composition from the feeding brush to or against the lower yarn cylinder. Note, the cylinder brushes receive their motion, either from a wheel upon one of their axis, which lies under the worm working upon the wheel *L*, or from a wheel upon the axis of the lower yarn beam working upon a wheel on the axis of the upper cylinder brush, which wheel conveys the motion to a wheel on the axis of the lower cylindrical brush. *X* is a dry brush for working the dressing composition into the yarn, and laying the filaments of it smooth. Fig. 10, *Y* is the yarn bobbin frame, which may be substituted for the yarn beam, at the discretion of the operator, from which the cloth is woven without the trouble of winding, warping and beaming. *Z* is a box or drawer for receiving the cloth.

In witness whereof, I the said EDMUND CARTWRIGHT have hereunto set my hand etc.

A. D. 1786.



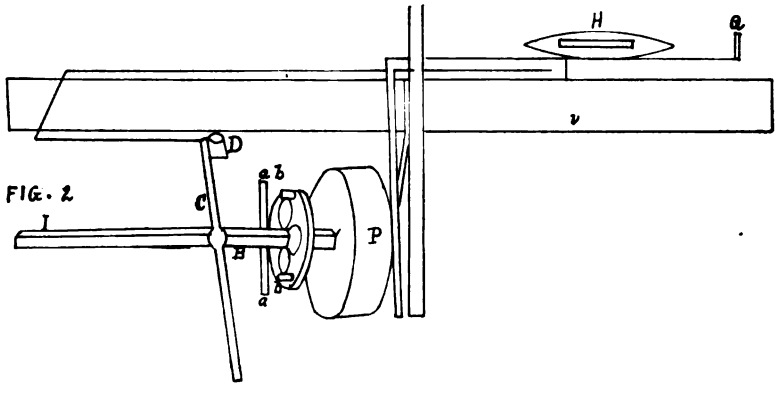


FIG. 2

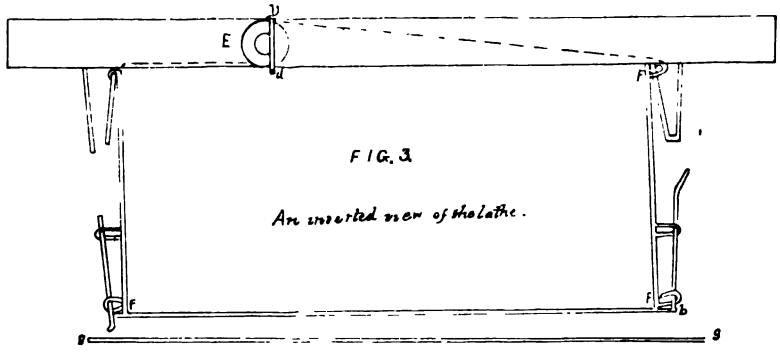
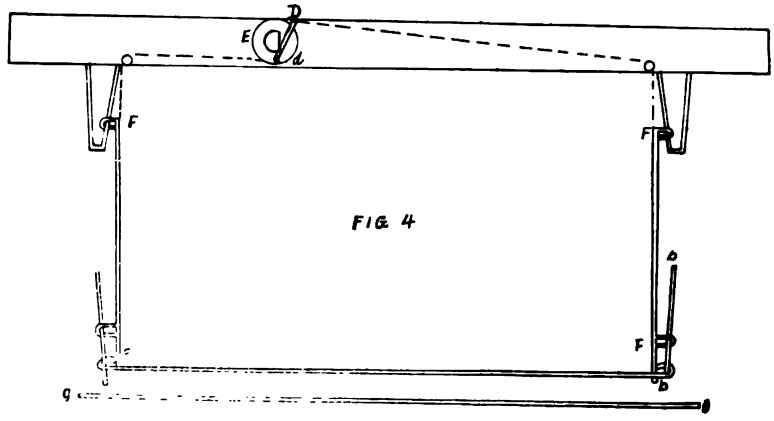
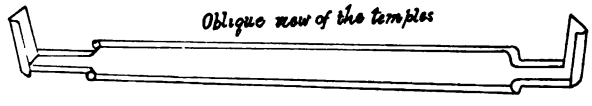
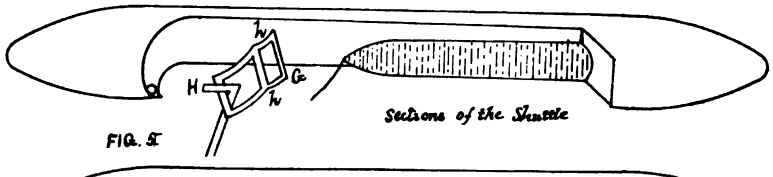


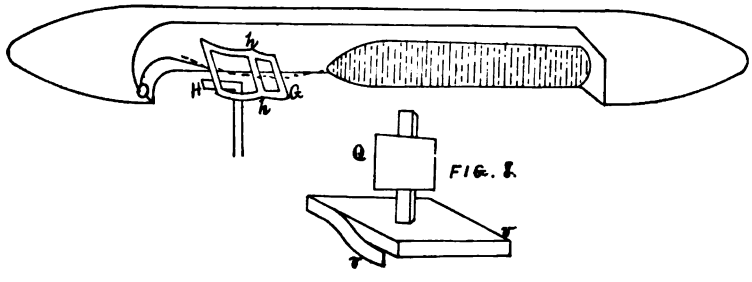
FIG. 3

An inverted view of the lathe.


D
E
d
F
F
FIG. 4
F
b
c
a


Oblique view of the temples


h
H
G
h
Sections of the Shuttle
FIG. 5


h
H
G
h
Q
FIG. 6
T
T

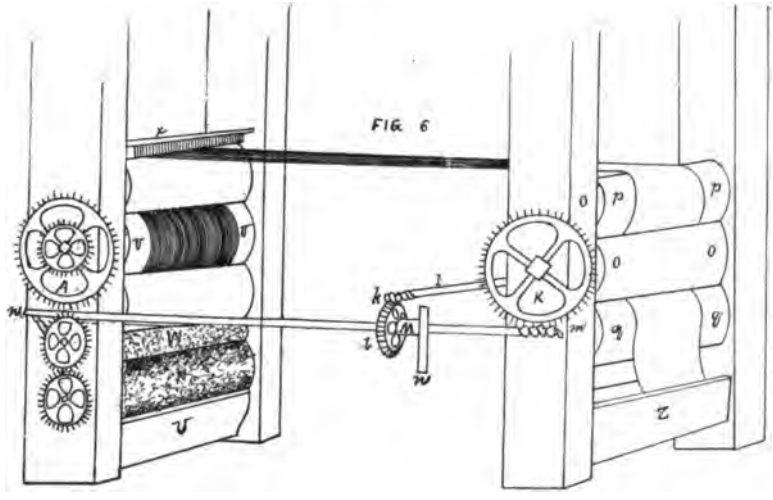


FIG. 6
A
K
W
V
U
T
S
P
O
Q
R
M
N

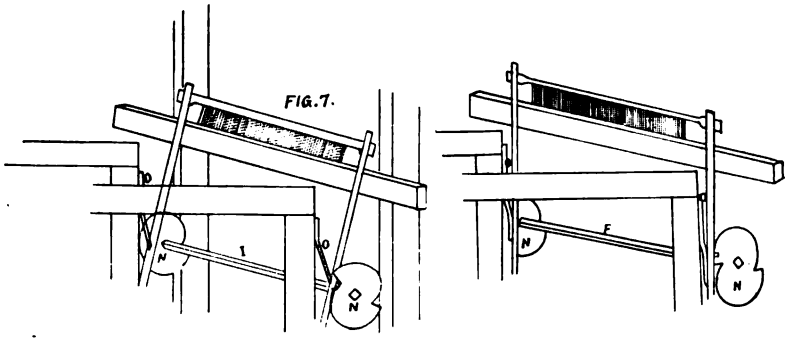


FIG. 7.
N
F

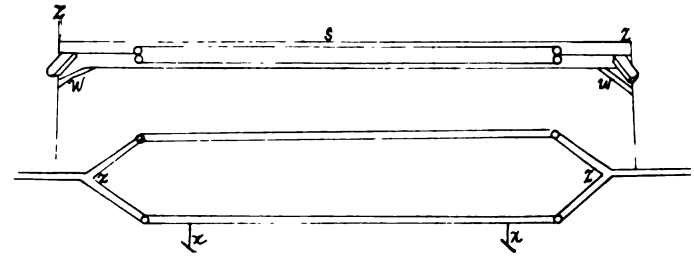


FIG. 9.

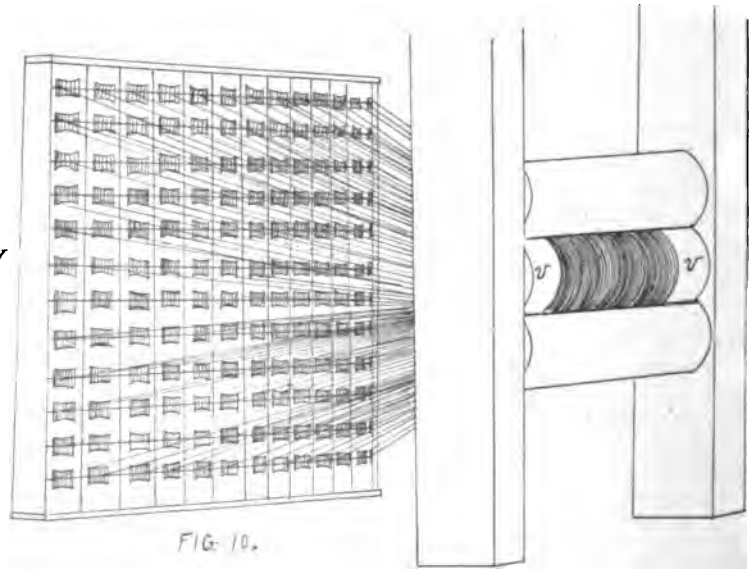
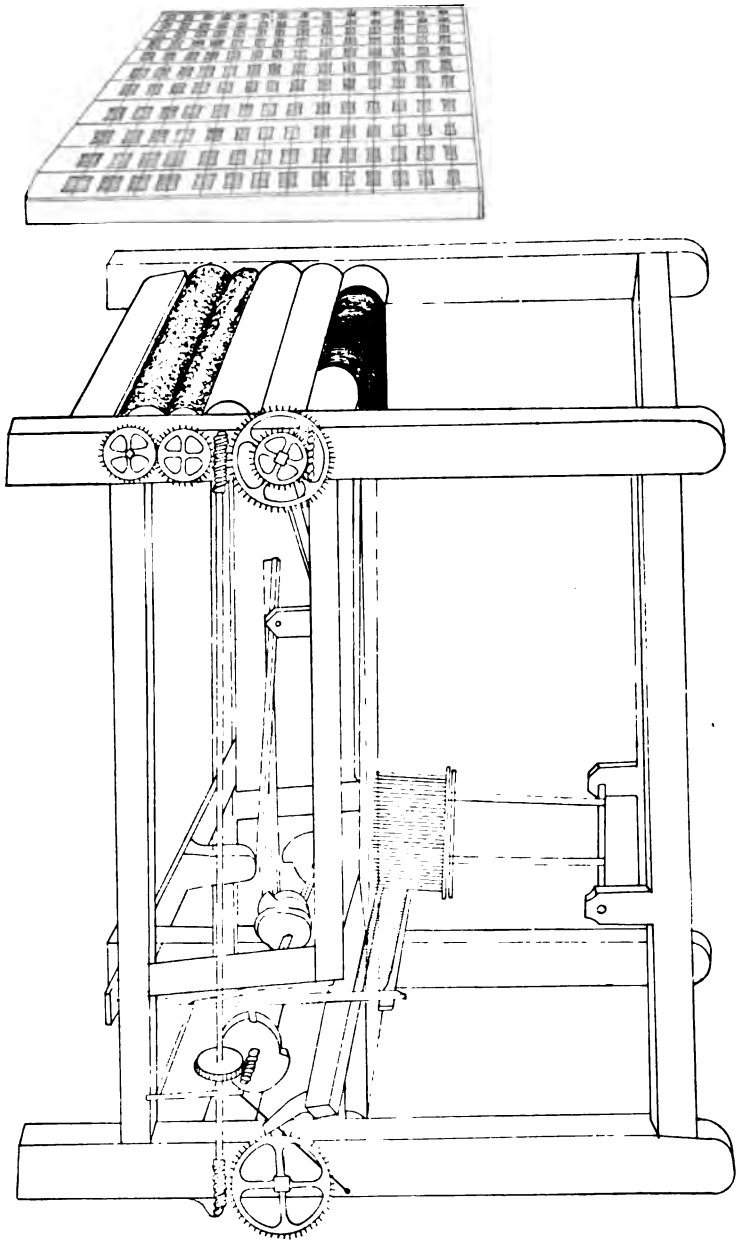


FIG. 10.



No. 1675.

Letter *A* in the figures No. 1, 5, 6, 7 and 8 is the outward frame, the dimensions of which must be varied according to the width of the cloth wanted to be wove.

The frame described is sufficient for weaving a piece 40 inches wide. It is six feet in width. Letter *B* in the figures 1 and 8 is the iron axis, which must be two inches square, and rounded four inches at one end for the wheel to run freely upon, fixed in the two bottom rails in the ends of the frames exactly under the slay boards when drawn back. Letters *C* in the figures 1 and 8 is the cog wheel upon the iron axis which receives its motion from the mill. Letter *D* in figures 1, 6 and 8 are four bands two of which must be fixed at each end of the iron axis by two bars of iron that fit tight on the axis, to which bars the hands must be screwed six inches from the inside of the bottom rails of the frame on which the axis rests, the two hands at each end must be fixed on opposite sides of the axis so that they may form a perpendicular and horizontal direction to each other, like the sails of a windmill, that when the two hands at one end of the loom are perpendicular, the two at the other end shall be horizontal. Letter *E* in figures 1, 4 and 8 shows the treading stock, which is a piece of wood 11 inches square and two inches thick; it must be fixed on the center of the iron axis by square collar on each side, with two pulleys made of cast iron, bushed with brass, turning on an iron pin, and fixed on each side of the treading stock at opposite corners, an inch and an half from the corners, as described in letter *G* in Fig. 8. Letter *G* in the figures 1, 5 and 8 show the pushing stocks, which are to be of the same size, and fixed in the same manner on the iron axis as the treading stock is fixed; each of the pushing stocks must be placed 20 inches from the treading stock; to each of these pushing stocks there must be four pieces of iron screwed or fixed on the outer veins of each pushing stock, at opposite directions to each other, two inches from each corner, with pulleys at the end of each piece of iron, which pieces of iron must be of such a length that when screwed into the stocks the extremity of the pulley shall be projected four inches from the outer rim of the pushing stock.

Letter *H* in the Fig. 5 shows the four pieces of iron, with pulleys, as they appear in looking through the frame from either end of it, and the same letter in Fig. 8 shows them as they appear in the front of the frame.

Letter *I* in figures 1 and 4 shows the treadles of which there must be

two. The figure No. 4 shows their form and shape, and they must be of dimensions proportioned to the machine. The pulleys marked letter *F* act upon the treadles in manner after mentioned. Letter *K* in the figure No. 1 shows cords, which must be fastened to each treadle, and wrapped once around each roller. There must be two rollers. The letter *L* in figure No. 1 shows the position of them; they rest upon a frame about four inches below the stay boards, which frame in the figure 1 is marked with the letter N. Two cords going around the rollers and marked in the figure No. 1 with the letter *N* are to be tied on the gear in the same figure, marked with the letter *O;* this gear marked with the letter *O* is delineated in the figure No. 5. Letter *P* in the figures 1 and 4 shows the grate by which the ends of the treadles are kept worked in their proper position. Letter *G* in the figures 1 and 2 shows the slay boards which moves, as in common looms, upon gudgeons resting upon the top end rails. Letter *R* in figures No. 1, 2 and 5 shows two arms or projections in the machine, each of which are six inches in length, and must be faced with iron, and fixed to the lower shell of the slay boards; upon which arms or projections, the four pieces of iron, with the pulleys described by the letter *H*, act in the working of the machine. Letter *S* in the figures 1, 2 and 3 shows the pulley which must be fixed on the fore side of the lower shell of the slay board, which pulleys have two grooves in the back side of them, as described in the drawing of the figure No. 3. Letter *T* in the figures No. 1, 2 and 3 shows the shuttle picker, which is a piece of wood one inch deep, one-half inch thick, and must be three inches longer than the breadth of the piece required to be wove, including the length of the shuttle with a piece of iron at each end, and which in these figures No. 1, 2 and 3 is marked with the letter *V*. This piece of iron must be faced with leather; it rests upon the pulley marked letter *S*, and is moved by them. Letter *U* in the figures 1 and 6 shows two wooden levers moving on an axle, fixed at one end to the middle back rail; the other end is raised by the hands marked letter *D* as they turn. Letter *W* in the figures 1 and 6 shows two iron springs, which must be each four feet long, one and one-half inches broad and one-fourth inch thick and fixed at one end to the floor, and tied at the other end to the levers marked letter *U*, by the cords marked in the same figures with the letter *X;* these springs are made more or less powerful by shortening the cords according to the force required. Letter *Y* in the figures 1, 2 and 6 describes two cords, one end of each of which is to

be fastened to the shuttle picker passing over the grooves on the back side of the pulleys marked letter *S*. The other end must be fastened near to the loose end of the levers marked with the letter *U*.

Letter *Z* in figures 1 and 5 describes two cords, which must be fixed to the loose end of the levers, marked letter *U* and also to the back end of the slay boards to prevent the levers from falling down too low to stay the shuttle.

Letter *a* in figures 1 and 5 shows two steel springs, one and one-fourth inches broad, one-eighth inch thick fixed to the low back rail upon which the low shell of the stay boards slides to keep them steady. There are also two wood springs, three feet long, one inch broad and one-fourth inch thick, one end of each of which is fixed to the middle of the back rail, to the other are tied cords fixed to the back of the slay boards. Letter *b* in figure 1 and 5 shows two levers six feet long turning on an axle fixed to the floor a little behind the back rail and weighted at the back end.

Letter *c* in figures 1 and 5 shows two straps, fixed at one end to the floor, passing over the warp beam marked with the letter *a*, the other end tied to the levers, marked with the letter *b*. Letter *d* in figures 1 and 7 shows the warp beam, which has a groove at one end, turned true upon the center for the straps *C* to slip over. Letter *e* in figures 1 and 7 shows small false beams for the warp to pass over. Letter *f* in figures 1 and 7 shows upright pieces of wood fixed in a frame upon the middle rail, which has grooves for the false beam to slide in.

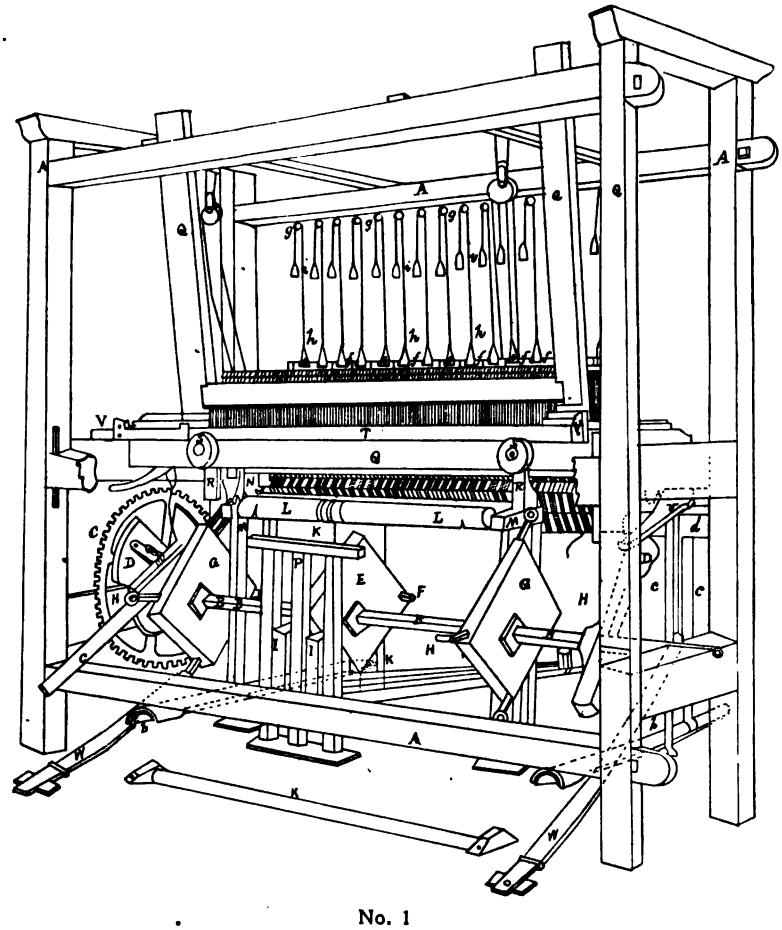
Letter *g* in figures 1 and 7 shows small pulleys fixed on the top rail. Letter *h* in figures 1 and 7 shows cords tied to the false beam *e*, and which pass over the pulley *g*, and have weights marked with the letter *i*, No. 1 and 7, tied to the other end of them, heavier or lighter according to the strength of the work. Letter *K* in figure No. 1 shows roller lying horizontally near the floor at the front of the loom, and resting at each end on standards fixed to the floor. Letter *I* in figures 1 and 8 shows the stopper, which is a piece of wood one inch and a half square, fixed to the middle back rail, and coming over the low front rail, having a piece marked letter *m*, in No. 1, and eight inches square fixed to it, in which the iron axis turns freely. Letter *n*, Fig. 8 shews the catch, a piece of iron turning on a pin in an iron standard fixed to one end of the iron bar to which the hands are screwed; it is made six inches long from the shoulder, with a point three inches long, which goes through the hand, and takes hold of the arm of the wheel, and is

kept in that position by a slender spring, which is fixed to the iron bar and acts against the tail of the catch. The machine being thus prepared, the warp is put upon the beam, and passing over the false beams *e*, goes through the gears and slay, as in other common looms, motion being given to the wheel *C*, by which work as usual from a water mill, horse mill, or any other kind of mill, an arm of the wheel takes hold of the catch *n*, which goes through the hand, and by that means turns round the iron axis; one of the pulleys *F*, on the right hand side of the treading stock *E*, presses down the right hand treadle *I*, by which means of the rollers *L*, and the cords *K* and *N* work the gear *O*. In the mean time two of the small pulleys *H*, upon the pushing stocks *G* have come against the two arms of the slay boards, and as the axis turns round, push toward the slay boards till they slide off the arms. The slay boards are drawn back by the wood springs, which are fixed to the low back rail. By this time the right hand lever *U* is raised up by one of the hands *D*, which as the axis turns further round drops off. The hand *D* being forced down by the spring *W* and by the cord *Y* plucks the shuttle picker *T*, which picks the shuttle through the warp. The axis having now made one-fourth of a revolution, another of the pulleys *F* on the left hand side of the treadle stock, presses down the left hand treadle; two other pulleys *H* on two other corners of the pushing stocks push forward the slay boards as before; the left hand lever is now raised by one of the hands *D*, and dropping off is forced down by the spring *W*, and by the cords *Y*, plucks the shuttle picker *T*, which picks the shuttle back again. The motions suceeed one another in the above order, the shuttle being picked four times in every revolution of the axis. When the welt is required to be laid closer, it may be done by increasing the weight on the ends of the levers *b* which makes the warp come slower off; the warp beams and the slay boards being always pushed to the same place, the piece will consequently be filled fuller of weft. If a fuller set is to be wrought, four shafts may be worked by fixing two additional rollers, which are worked by two breakers, as is in use in common looms, and for any kind of figured work any number of treadles may be worked by an additional number of trading stocks in the same axis, or, if neccessary, on the other fixed parallel to it. For narrow or light goods, the iron pushers *H* may be fixed in the treading stock, and work a single arm fixed in the middle of the slay boards when the shuttle happened to catch in the shed, the small false beam cover, which that part of the warp passes where the

shuttle is caught give way, sliding down the grooves in the upright pieces *f*, and driving up the weights *i*, by which means the warp is so much slackened as to prevent the shuttle from breaking the threads; when the shuttle is taken out, the weights draw the false beams and the warp into the former position. As the piece is wove, it passes over the roller fixed upon the breast beam and under the roller *K*. and afterwards over other rollers is taken up by a weight. When the loom is required to be stopped, the stopper is pushed against the tail of the catch by the weaver's foot which throws the points out of the wheel. The wheel is then set at liberty, and turns round upon the axis, and the loom immediately stands still.

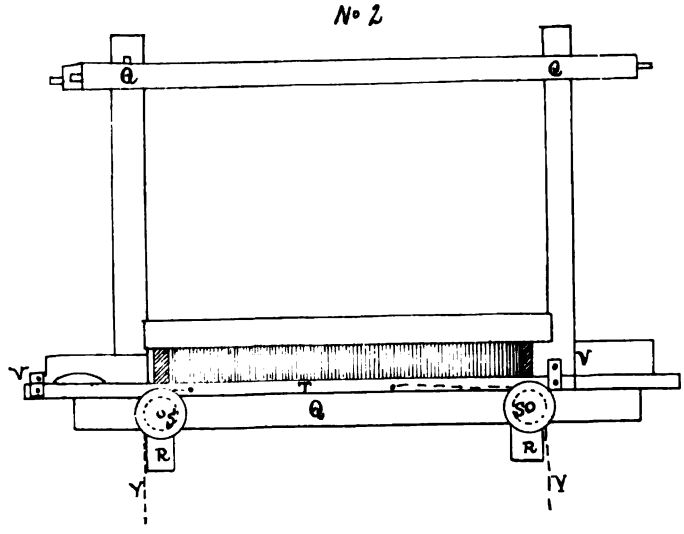
In witness, etc.,

THOMAS CLARK.



No. 1

No 2



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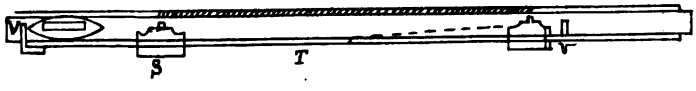
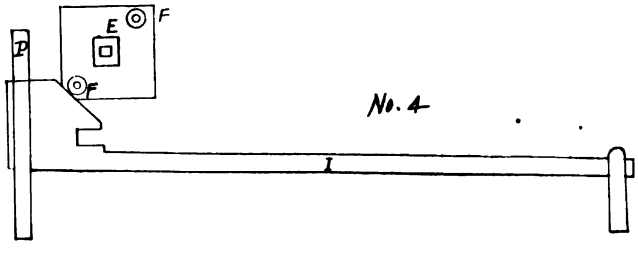
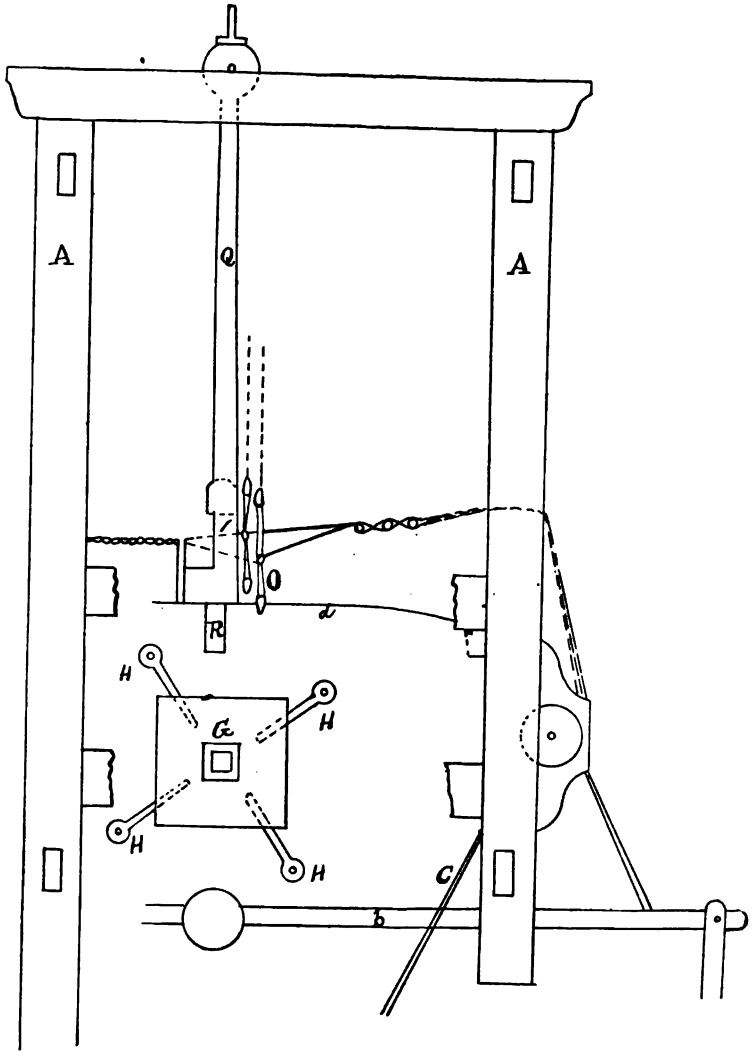




No. 4

No. 5



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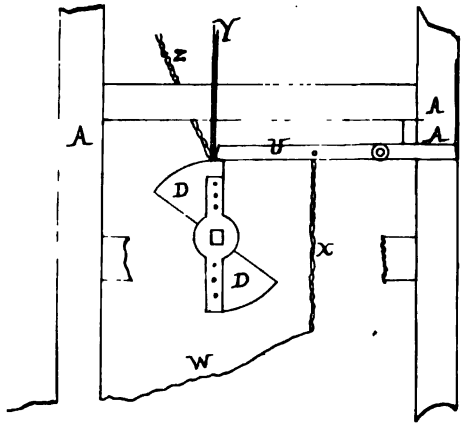

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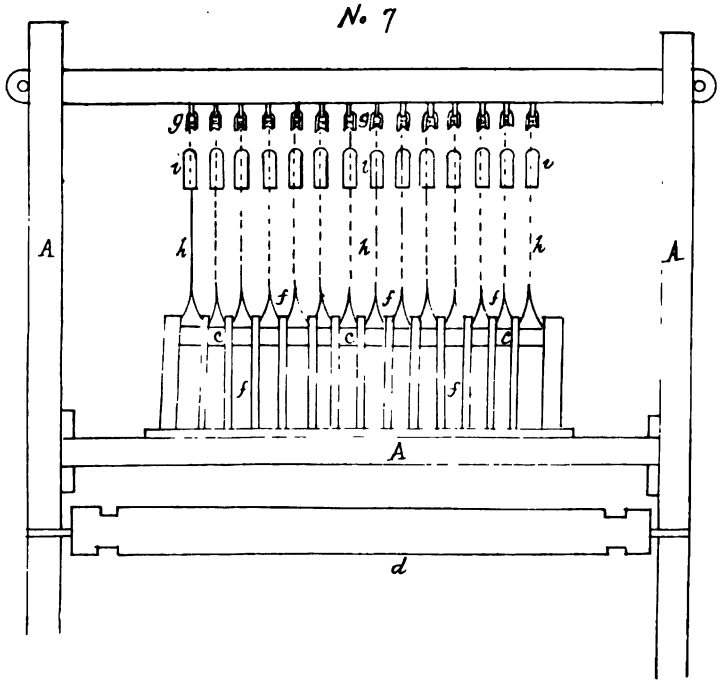

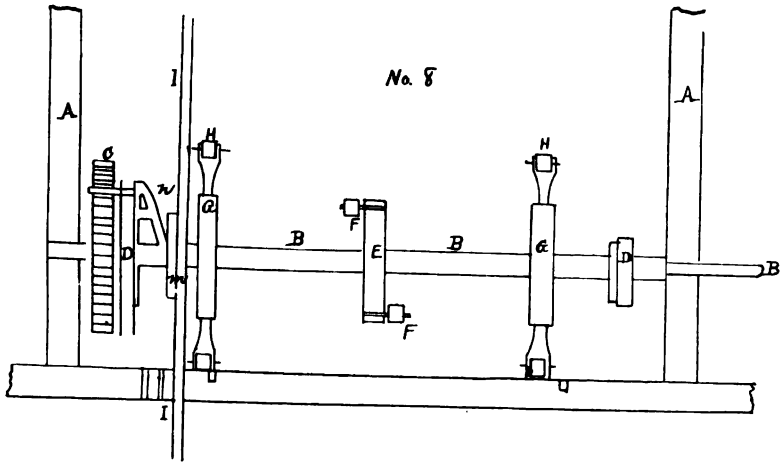
No. 8
A
A
I
I
G
H
H
B
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It is a matter of considerable interest that stop motions for both warp and filling were thus early invented. It would seem to be of more than passing interest to our friends in Hopedale.

It is perfectly evident from a careful study of the above patents that up to the date of the last, nothing had been invented that had gone into ordinary commercial practice. We must look elsewhere to see what additional light can be obtained.

R. WATELY COOK TAYLOR, who is inspector of factories in England, in his work entitled "The Modern Factory System," writes regarding the power loom as follows:

"The power loom was the invention of a clergyman, the Rev. EDMUND CARTWRIGHT. The circumstances attending it are to be found described in many places—amongst others in the current edition of the "Encyclopedia Britannica" in the inventor's own words. The endeavor to construct an automatic loom had been several times made before. In the 17th century, writes MARX,[1] nearly all Europe experienced revolts of the work people against the ribbon loom; a machine for weaving ribbons and trimmings, called in Germany, Bandmuhle, Schnurmuhle and Muhlenstuhl; and there had certainly been a previous and similar one in existence, for 'the Abbe Lancellotti, in a work that appeared in Venice in 1636, but which (says MARX) was written in 1579, tells of a certain ANTHONY MILLER of Dantzig, that he saw about 50 years ago (namely, at the very beginning of the sixteenth century), in that town, a very ingenious machine which weaves four to six pieces . . . . . but the mayor being apprehensive that this invention might throw a large number of workmen on the streets, caused the inventor to be secretly strangled or drowned. This machine, he adds, was in fact the precursor of the mule and the power loom, and of the industrial revolution of the eighteenth century. It enabled a totally inexperienced boy to set the whole loom, with all its shuttles, in motion by simply moving a rod backward and forward, and in its improved form produced 40 to 50 pieces at once."[1] It was sometimes driven by water power[2]. Another loom, also moved by water power, was contrived by M. DE GENNES much about

the same time, and is described in the Philosophical Transactions of the Royal Society for 1678 (Vol. II, p. 439 of Dr. HUTTON'S abridgement), as a new engine to make linen cloth without the help of an artificer[8] and M. VAUCANSON, a Frenchman, invented a better known one about a century later. None of these inventions, it is clear, had come to much. Nor indeed was CARTWRIGHT'S at first more successful. In 1787 he took out his final patent for it, and immediately afterwards entered regularly into business as a manufacturer at Doncaster; but the enterprise was a costly failure. Other attempts followed. About 1790 Messrs. GRIMSHAW, of Gorton, under a license from Dr. CARTWRIGHT, erected a weaving factory at Knott Mill, Manchester, and attempted to improve the power loom at great cost to themselves, but they failed, and the factory being burnt down shortly after abandoned the undertaking altogether.

"In 1793 Mr. KINLOCH, of Glascow, 'with the assistance of an operative joiner and clockmaker,' set up what is described as the 'first power loom ever made,' but the attempt was not persevered with at the time. He afterwards removed to Lancashire, where several of these looms were worked by him in the West Houghton district with more success, but destroyed in the riots of 1813. In 1794 a power loom was invented by Mr. BELL of Glascow, which was likewise abandoned. On the 6th of June, 1796, Mr. ROBERT MILLER, also of Glascow, took out a patent for one, which a spirited neighbor, Mr. JOHN MONTEITH, 'adopted in 1801 and fitted up a mill at Pollockshaw with two hundred looms,' but it was 'several years before the business was made to answer.' At length some definite progress was made. In 1803 and 1804, respectively, Messrs. Radcliffe & Ross, of Stockport, took out, in the name of their assistant, THOMAS JOHNSON, four patents for improvements in the weaving process, and Mr. HORROCKS, a manufacturer of the same town, others in 1803, 1805, and 1813, respectively, for improvements in the loom itself, the common result of all of which was to establish at length the value of CARTWRIGHT'S invention and start it on a career of unexampled prosperity. At the last

named date (1813) there were not more than 100 power looms in use. In 1820 there were already over fourteen — and in 1829 nearly sixty — thousand. In a few years more (namely, in 1833) Mr. BAINES estimated 85,000 in England, 15,000 in Scotland, and some hundreds in Ireland."

Perhaps the best authority we have on early cotton manufacturing is BAINES and I quote from his "History of the Cotton Manufacture."

"In the year 1738, Mr. JOHN KAY, a native of Bury, in Lancashire, then residing at Colchester, where the woolen manufacture was at that time carried on, suggested a mode of throwing the shuttle, which enabled the weaver to make nearly twice as much cloth as he could before. The old mode was to throw the shuttle with the hands, which required a constant extension of the hands to each side of the warp. By the new plan, the lathe (in which the shuttle runs) was lengthened a foot at either end, and by means of two strings attached to the opposite ends of the lathe, and both held by a peg in the weaver's hand, he, with a slight and sudden pluck was able to give the proper impulse to the shuttle. The shuttle thus impelled was called the fly-shuttle, and the peg was called the picking-peg, *i. e*, the throwing-peg. This simple contrivance was a great saving of time and exertion to the weaver and enabled one man to weave the widest cloth, which had before required two persons. "Mr. KAY brought this ingenious invention to his native town and introduced it among the woolen weavers in the same year, but it was not much used among the cotton weavers until 1760. In that year Mr. ROBERT KAY, of Bury, a son of Mr. JOHN KAY, invented the drop box, by means of which the weaver can at pleasure use any of three shuttles, each containing a different colored weft, without the trouble of taking them from and replacing them in the lathe."*

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*GUEST p. 8. Mr. GUEST derived his information on these points "from a manuscript lent to him by Mr. SAMUEL KAY, of Bury, son of Mr. ROBERT KAY, the inventor of the drop box" p. 30.

These inventions, like every other invention which has contributed to the extraordinary advance of the cotton manufacture, were opposed by the workmen, who feared that they would lose their employment; and such was the persecution and danger to which JOHN KAY was exposed, that he left his native country and went to reside in Paris.

The spirit of improvement which had carried the spinning machinery to so high a degree of perfection was next directed to the weaving department and did not rest till that operation, as well as spinning, was performed by machinery. A loom, moved by water power, had been contrived by M. DEGENNES so far back as the seventeen century; it is described in the Philosophical Transactions of the Royal Society for 1678 Vol. II. p. 439 of Dr. Hutton's Abridgement) as "a new engine to make linen cloth without the help of an artificer," and the description given of its advantages deserves to be quoted from the resemblance between the advantages which that loom professed to attain and those which the modern power loom actually does attain. "The advantages of this machine are these: 1. That one mill alone will set ten or twelve of these looms at work. 2. The cloth may be made of what breadth you please, or at least much broader than any which had hitherto been made. 3. There will be fewer knots in the cloth, since the threads will not break as fast as in other looms, because the shuttle that breaks the greater part can never touch them. In short, the work will be carried on quicker and at less expense, since, instead of several workmen, which are required in making of very large cloths, one boy will serve to tie the threads of several looms as fast as they break, and to order the quills in the shuttle."

It is probable that this machine, from its unwieldy construction, did not secure in practice the advantages which it promised in theory, as it is not known to have ever come into use. About the middle of the eighteenth century, a swivel loom was invented by M. VAUCONSIN; and in 1765 a weaving factory, probably filled with those looms, was erected by Mr. Gartside at Man-

chester, but no advantage was realized, as a man was required to superintend each loom.

In 1785 the Rev. Dr. EDMUND CARTWRIGHT, of Hollanderhouse, Kent, (brother of Major CARTWRIGHT, the well known advocate of radical reform,) invented a power loom, which may be regarded as the parent of that now in use. The circumstances which led to the invention have been thus described in a letter from himself to Mr. BANNATYNE, inserted in the Encyclopedia Brittannica:

"Happening to be at Matlock in the summer of 1784, I fell in company with some gentlemen of Manchester, when the conversation turned on ARKWRIGHT'S spinning machinery. One of the company observed, that as soon as ARKWRIGHT'S patent expired, so many mills would be erected and so much cotton spun, that hands could never be found to weave it. To this observation I replied, that ARKWRIGHT must then set his wits to work to invent a weaving mill. This brought on a conversation on the subject, in which the Manchester gentlemen unanimously agreed that the thing was impracticable; and in defence of their opinion they adduced opinion which I certainly was incompetent to answer or even to comprehend, being totally ignorant of the subject, having never at that time seen a person weave. I controverted, however, the impractibility of the thing by remarking that there had lately been exhibited in London an automaton figure which played at chess. Now you will not assert, gentlemen, said I, that it is more difficult to construct a machine that shall weave, than one which shall make all the variety of moves which are required in that complicated game.

"Some little time afterwards a particular circumstance recalling this conversation to my mind, it struck me that, as in plain weaving, according to the conception I then had of the business, there could only be three movements, which were to follow each other in succession, there would be little difficulty in producing and repeating them. Full of these ideas, I immediately employed a carpenter and smith to carry them into effect. As soon as the machine was finished, I got a weaver to put in the warp,

which was of such materials as sail cloth is usually made of. To my great delight, a piece of cloth, such as it was, was the produce. As I had never before turned my thoughts to anything mechanical, either in theory or practice, nor had ever seen a loom at work, or knew anything of its construction, you will readily suppose that my first loom was a rude piece of machinery. The warp was placed perpendicularly, the reed fell with at least half a hundred weight, and the springs which threw the shuttle were strong enough to have thrown a Congreve rocket. In short, it required the strength of two powerful men to work the machine at a slow rate and only for a short time. Conceiving in my great simplicity that I had accomplished all that was required, I then secured what I thought a most valuable property, by a patent of 4th of April, 1785. This being done, I then condescended to see how other people wove, and you will guess my astonishment when I compared their easy modes of operation with mine. Availing myself, however, of what I then saw, I made a loom, in its general principles nearly as they are now made. But it was not until the year 1787 that I completed my invention, when I took out my last weaving patent, August 1st of that year."

Dr. CARTWRIGHT was led by his invention to undertake manufacturing with power looms at Doncaster, but the concern was unsuccessful and he at length abandoned it. He afterwards obtained other patents for wool-combing, in which he was as unfortunate as in his power loom, although an act was passed in 1801 prolonging the latter patents. Though he had a handsome paternal fortune, his affairs became inextricably embarassed; but he was more fortunate than most inventors in obtaining from parliament in 1809, a grant of £10,000 as a reward for his ingenuity.

About 1790, Messrs. GRIMSHAW, of Gorton, under a license from Dr. CARTWRIGHT, erected a weaving factory at Knott Mills, Manchester, and attempted to improve the power loom, at great cost to themselves. They did not succeed, and the factory being burned down they abandoned the undertaking.

In 1794, a power loom was invented by Mr. BELL, of Glasgow, which was likewise abandoned. On the 6th of June, 1796, Mr. ROBERT MILLER, of Glasgow, took out a patent for a machine of this nature; which a spirited individual, Mr. JOHN MONTEITH, adopted in 1801, and fitted up in a mill at Pollokshaws, Glasgow, with 200 looms. It was several years before the business was made to answer.

The great obstacle to the success of the power loom was, that it was necessary to stop the machine frequently, in order to dress the warp as it unrolled from the beam; which operation required a man to be employed for each loom, so that there was no saving of expense. This difficulty was removed, by the invention of an extremely ingenious and effectual mode of dressing the warp before it was placed in the loom.

The dressing machine was produced by Messrs. Radcliffe & Ross, cotton manufacturers, of Stockport, but they took out the patent in the name of THOMAS JOHNSON, of Bredbury, a weaver in their employment, to whose inventive talent the machine was chiefly owing. Mr. WM. RADCLIFFE, who had conceived the utmost alarm at the consequences of exporting cotton yarn, and who spent a considerable part of his life in endeavors to prevent it, justly thought that the most effectual way of securing for this country the manufacturing of yarn, was to enable the English to excel as much in weaving as they did in spinning. He saw the obstacles to the accomplishment of this object, but being a man of determined purpose, he shut himself up in his mill on the 2nd of January, 1802, with a number of weavers, joiners, turners and other workmen, and resolved to produce some great improvement. Two years were spent in experiments. He had for his assistant, THOMAS JOHNSON, an ingenious but dissipated young man, to whom he explained what he wanted, and whose fertile invention suggested a great variety of expedients, so that he obtained the name of the "conjurer" among his fellow-workmen. JOHNSON'S genius and RADCLIFFE'S judgment and perseverance at length produced the dressing machine; an admirable inven-

tion, without which the power-loom could scarcely have been rendered efficient.

The process is thus briefly described: "The yarn is first wound from the cop upon bobbins by a winding machine, in which operation it is passed through water to increase its tenacity. The bobbins are then put upon the warping-mill and the web warped from them upon a beam belonging to the dressing-frame. From this beam, placed now in the dressing-frame, the warp is wound upon the weaving beam, but in its progress to it, passes through a hot dressing of starch. It is then compressed between two rollers to free it from the moisture it had imbibed with the dressing, and drawn over a succession of tin cylinders heated by steam to dry it; during the whole of this last part of its progress being lightly brushed as it moves along, and fanned by rapidly revolving fanners".[1] The dressing here spoken of is merely a size of paste made of flour and water,[2] now generally used cold; and the use of it is, to make the minute fibres, which as it were, feather the yarn, adhere closely to it, so that the warp may be smooth like catgut. The brushes essentially aid in smoothing the yarn, and distributing the size equally over it, and by means of the fan and the heated cylinders the warp is so soon dried that it is wound upon the beam for the loom within a very short space after passing through the trough of paste. This machine from the regularity and neatness of its motions and its perfect efficacy, is equally beautiful and valuable.

RADCLIFFE and his partner took out four patents in the years 1803 and 1804; two of them for a useful improvement in the loom—the taking up of the cloth by the motion of the lathe; and the other two for the new mode of warping and dressing. JOHNSON, in whose name they were taken out, received by deed the sum of £50 in consideration of his services and continued in their employment. RADCLIFFE'S unremitted devotion to the perfecting of this apparatus and other unfortunate circumstances, caused the affairs of his concern to fall into derangement. He failed twice or three times and he was as unsuccesful in his well-meant but foolish opposition to the exportation of

yarn, as in his private undertakings. His book, entitled "Origin of the New System of Manufacture commonly entitled 'Power Loom Weaving', and the purposes for which this system was invented and brought into use, fully explained in a narrative, containing WM. RADCLIFFE'S Struggles through life to remove the cause which had brought this Country to its present crisis: written by himself, 1828"; displays a mind shrewd and bold, but invincibly obstinate and contracted.

The dressing machine itself has now in some establishments been superseded, and the warp is dressed in a shorter and simpler way by an improved sizing apparatus.

By the aid of JOHNSON and RADCLIFFE'S invention, the power loom became available. A patent for another power loom was taken out in 1803, by Mr. HORRICKS, cotton manufacturer, of Stockport, which he further improved, and took out subsequent patents in 1805 and 1813. One of the principal improvements in this loom, the mode of taking up the cloth, RADCLIFFE states to have been copied from his hand loom, and to have been the invention of THOMAS JOHNSON. Mr. PETER MARSLAND, of Stockport, an enterprising spinner, took out a patent for a power loom with a double crank, in 1806, but from its complexity it was not adopted by any one but himself. Superior cloth, however, was made by it. HORROCK'S loom is the one which has now come into general use; it is constructed entirely of iron and is a neat, compact and simple machine, moving with great rapidity and occupying so little space that several hundred may be worked in a single room of a large factory. HORROCKS, sharing the common destiny of inventors, failed and sunk into poverty. This retarded the adoption of the machine, but independent of this, the power loom and dressing machine came very slowly into favor. In 1813, there were not more than 100 of the latter machines and 2400 of the former in use. Yet this was enough to alarm the hand loom weavers, who, attributing to machinery the distress caused by the orders in Council and the American war, made riotous opposition to all new machines, and broke the power looms set up at West

Houghton, Middleton and other places. Nevertheless, the great value of the power loom having now been proved, it was adopted by many manufacturers, both in England and in Scotland; and it will no doubt in time supersede the hand loom. The rapidity with which the power loom is coming into use is proved by the following table, the particulars of which were stated by R. A. SLANEY, Esq., M. P., in the House of Commons, on the 13th of May, 1830, and which rest on the authority of Mr. KENNEDY.

Number of Power Looms in England and Scotland.

	In 1820.	In 1829.
In England,	12,150	45,500
In Scotland,	2,000	10,000
Total,	14,150	55,500

This number would appear to have been somewhat underrated. Dr. CLELAND states that in 1828, the Glasgow manufacturers had in operation, in that city and elsewhere, 10,783 steam looms, and 2,060 more in preparation; total 12,843. He supposed there was an increase of ten per cent. between 1828 and 1832, which would make the number 14,127 in the latter year. This is independent of other parts of Scotland, unconnected with Glasgow. In 1833 evidence was given before the Common's Committee on Manufactures, Commerce, &c., that "in the whole of Scotland there were 14,970 steam looms." We may, therefore, safely take the number of power looms in Scotland at the present time at 15,000.

In England the great increase took place during the years of speculation, 1824 and 1825; and comparatively few power loom mills were built betwixt that time and 1832. But in 1832-1833 and the former part of 1834, the trade has been rapidly extending, many mills have been built, and many spinners have added power loom factories to their spinning mills.[8]

Mr. KENNEDY'S estimate in 1829 was probably too low for England as well as for Scotland. At all events there are good reasons for believing that there must now be 85,000 power

looms in England. This conclusion is deduced from a computation of the number of workmen employed in power loom weaving, founded on actual returns obtained by the factory commissioners from the cotton mills in Lancashire and Cheshire. The particulars of the estimate will be given in a future chapter, and it will be seen that the estimate has been made in a spirit the reverse of exaggeration. It is also supported by the calculations of Mr. BANNATYNE and Messrs. Samuel Gregg & Co., the spinners and manufacturers, of Bury. At the present time, the machine makers of Lancashire are making power looms with the greatest rapidity, and they cannot be made sufficiently fast to meet the demands of the manufacturers. The result we have arrived at is as follows:

Estimated Number of Power Looms in Great Britain in 1833.

In England,	85,000
In Scotland,	15,000
Total,	100,000

While the number of power looms has been multiplying so fast, the hand looms employed in the cotton manufacture are believed not to have diminished between 1820 and 1834, but rather to have increased. In the former years they were estimated by Mr. KENNEDY at 240,000. In 1833 Mr. JAMES GRIMSHAW, a spinner and manufacturer, of Colne, gave his opinion, before the Committee of the Commons on Manufactures, &c., that the number of hand loom cotton weavers in the kingdom was about 250,000, whilst Mr. GEORGE SMITH, manufacturer, of Manchester, estimated them at only 200,000. In the present year (1834) several intelligent workmen and manufacturers from Glasgow gave evidence to the Commons' Committee "on hand loom weavers" that there were 45,000 or 50,000 hand loom weavers in Scotland alone.[4]

In looking up the various points involved in the early history of the power loom, I found many references to a report made to Parliament in which the condition of the operatives was de-

scribed, both before and after the introduction, *commercially*, of the power loom. This is done in great detail, and in it I find the following corroboratory evidence.

In the report of the commissioners (Great Britian) on the condition of the hand loom weavers — 1841 — page 27, Mr. JAMES SCOTT states: "I have been carrying on the cotton business for the last 15 years. In the year 1825, I employed between two and three hundred weavers, most of them on corduroys, some on calicoes. The trade flourished up to 1829. There were at that time 1500 to 2000 cotton weavers employed in Baudon and its vicinity. After the year 1829 I found that we could not compete with the English goods that were sent into the market. *The power looms swept away our trade in three or four years.*"

Same report. Testimony (page 43) showing cause of rise of wages in hand loom weaving.

"That arose from a discovery which some of the gentleman may know, I mean by the fly shuttle, a very simple improvement, but it enabled a man to do three times as much work as he did before with his hand."

"In what year was that?"

"Very early, the cotton manufacture began about 1783, this was about 1788 or 1789 it was introduced, that fly shuttle, and in the year 1790 or '91 it was almost universal.

BAINES'S "History of the Cotton Manufacture" is the standard today for the time of which it treats, and the extracts given above are conclusive even if they were supported by no other testimony.

WM. R. BAGNALL, M. A., in his history of the "Textile Industry of the United States," of which only volume I. has been published, which includes the time from 1639 to 1810, a work of exhaustive industry and of great value, says: "During the year 1816, the first effective power loom for weaving cotton cloth, in use in Rhode Island, was set up in the Lyman Mill. WILLIAM GILMOUR, a machinist, had come the previous year to this country from Glascow, Scotland, arriving in Boston in Septem-

ber, 1815. He had been acquainted with the power loom and dressing machine before he left Scotland. He brought to Boston certain small articles manufactured in Scotland, and, in selling them, became acquainted with ROBERT ROGERSON, a commission merchant of Boston, who, in the previous July, had purchased a cotton mill in North Uxbridge, Mass. On being told by GILMOUR that he had been employed in Scotland in weaving on the power loom, and that he understood the construction of the power loom and dressing machinery, Mr. ROGERSON invited him to accompany him to North Uxbridge. From that place they went to Slatersville, where Mr. GILMOUR was introduced to JOHN SLATER, one of the owners and the manager of the mill in that place. Mr. GILMOUR proposed to Mr. SLATER to build machinery for power loom weaving, to to have nothing for his labor unless he should be able to put the looms into successful operation. JOHN SLATER was warmly in favor of giving him the desired opportunity, but was overruled in the matter by his older and more conservative brother, SAMUEL, who considered it unwise to make any investment at that time when the prospects of the cotton manufacture were so discouraging. Mr. GILMOUR, however, was furnished with employment, and worked for several months in the machine shop of the factory at Slatersville. He then determined to make another effort to introduce the power loom, and went to the mill of the Lyman Cotton Manufacturing Company, where he had an interview with Judge LYMAN, who immediately contracted with him for the construction of a loom on the model of the Scotch loom. Though known at first in this country as the 'Scotch loom,' it was invented and first put into operation by WM. HORROCKS, of Stockport, England, patents for its original device and subsequent improvements having been granted April 20th, 1803, May 14th, 1805, and July 31st, 1813. It seems to have been the first successful loom for weaving cotton fabrics by power, although numerous other looms had been constructed, both in Great Britain and in this country, for the same purpose.

"An effective power loom for weaving cotton goods had been

constructed more than a year before the coming of WILLIAM GILMOUR to this country, and was at that time in successful operation at Waltham, Mass., reference to which will be made in our sketch of the Boston Manufacturing Company."*

To sum up, it seems perfectly clear from a study of the above data, that while the idea of a loom driven by power, either of "water, steam, fire or air" had been conceived before 1800, nothing practical had been done except by two men, CARTWRIGHT and HORROCKS. And the power loom, invented either by one or the other of these two men, first came into actual use about 1810, and from that date to 1813 only a small number of power looms were in use in England. Mr. LOWELL returned from England in 1813, and in 1814 the first power loom ever run in this country was in operation in Waltham, and from this beginning starts the growth of cotton manufacture in this country. While undoubtedly cloth was made at the mill in Beverly, it was made, as the evidence shows, by hand cards and on hand looms with a fly shuttle, and this mill was in no sense a forerunner of the modern cotton mill, so that this distinction can be fairly claimed by the Boston Manufacturing Company.

*I have been informed by the publishers of BAGNALL'S history that the manuscript of the second volume was so nearly completed before his death that it is practically ready for publication, but the first volume was not a success financially, and its publication was only possible by the help of certain men who were interested in having an accurate and comprehensive history of the textile industry, and who advanced money for this purpose. It seems especially desirable that this second volume should also be published, and any movement that could be made towards that end would complete a work of great value.

1. Encyclopedia Britannia, "Cotton Manufacture."

2. The consumption of flour in the cotton manufacture is estimated at not less than 42,301,384 lbs. in the year or 215,824 barrels (of 196 lbs.) or 176,256 loads (of 240 lbs. each).—*Burn's Commercial Glance for* 1832. Bengal flour, an article lately introduced into this country, is found to answer well for dressing.

3. Mr. WM. R. GREGG, an extensive spinner and manufacturer at Bury, gave evidence before the Select Committee of the House of Commons on Manufactures, Commerce and Shipping, (7th August, 1833) that the "number of power looms had

The PRESIDENT. We will now listen to a paper from Captain JAMES G. HILL of Lowell on "The Relation of Steam to Water Power."

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been very materially increased of late years in and about Bury", and also at Stockport, Bolton, Ashton, and in Cheshire. He stated that he did not know any person who was now building a spinning mill without addition of a power loom mill. (*Report, p.* 677).

4. See Report: the evidence of WILLIAM BUCHANNON, THOS. DAVIDSON, ESQ., and HUGH MCKENZIE.

THE RELATION OF STEAM TO WATER POWER.

JAMES G. HILL, Lowell, Mass.

In presenting a paper to the members of the New England Cotton Manufacturers' Association on the subject of the relation of steam to water power, I do not presume to write any thing new but hope I may interest, at least, a small number and to do so shall treat the water power more from the standpoint of the particular conditions existing in such manufacturing centres as Lowell, Lawrence, Holyoke, Manchester and similar places situated on or near the banks of rivers where water falls are available and which have been converted into positive powers and are owned or controlled in part or the whole by parties or corporations other than the mills proper, and where a fixed charge is made for all or some portion of the water power supplied.

In general, it may be said that any water power furnished without charge, except that of building the plant and the expenses of maintaining the same, is cheaper than steam power or any other known power.

To prove this statement it will be necessary to make a comparison between the costs of the two powers. To do this I have made the tables accompanying this paper marked *A* and *B* as the simplest and plainest method of proof. Of course we know that whenever water power is furnished by a separate company, distinct from the mills, at a fixed or variable charge, water power may soon become an expensive luxury, but in order to determine at what point water power or steam power is the cheaper we must turn to the tables for a comparison.

I assume the average water and steam power plants will cost about 50 dollars per H. P. each. From data recently obtained

and careful estimates made of large water powers like Lowell, for instance, and steam plants in and out of Lowell the above cost of the two plants can be readily proven, but as such demonstrations would require much more space and time than belongs to this paper I omit them here.

The statement has been made that steam power at tide water is as cheap or possibly cheaper than water power inland, and of course, if true, the advantages in freights and the nearer proximity to commercial centres is apparent.

But I think we can show that no steam power, no matter how cheap coal may be, is as cheap as water power without charges, other than those incidental to its production, that is to say, without any fixed charges for the use of water power.

Again, to determine this claim in behalf of water power, we must examine the tables.

In partial explanation of the tables I would say I have assumed the life of a water wheel to be about thirty (30) years and a steam engine about twenty (20) years, while the life of a steam boiler is placed at about ten (10) years only, because with the present high pressure of about 150 pounds per square inch or more at which modern boilers are run it is questionable whether it is prudent to risk a longer life.

The other items in the tables are made up of running expenses, repairs, renewals, taxes, insurance, interest and in fact all the factors that make up an actual cost of producing one horse power of either steam or water.

In further explanation of the tables I must apologize to the Association for making table *B*, on steam power, on a basis of 58 hours per week, which is the statute limit of working time in Massachusetts, instead of 60 hours per week.

This table was nearly completed when I received an invitation from your secretary to read a paper before the Association and since then I have been unusually busy, therefore have been unable to make a new table.

In table *A*, on water power, the various charges for all rates of surplus water are made on a basis of 282 days per year, which is the time allowed in Lowell and I think Lawrence.

To obtain 282 days as the actual running time for which surplus water power is charged, subtract Sundays, holidays and Saturday afternoons, when the mills are idle, from the total number of days in a year.

Of course where more than 282 days are counted the additional days can be readily reckoned and added to column five table *A*.

TABLE A.—WATER POWER.

Yearly Cost of One Horse Power of Water.

Price per Mill Power in Dollars.	Number of Days in a Year.	Amount Paid for Water.	Indicated Horse Power.	Cost of Water for One Horse power.	Running Expenses.	Repairs.	Total Cost of Water Expenses and Repairs.	Wheel Renewals.	Interest on Plant.	Taxes.	Insurance.	Total Yearly Cost of One Horse Power.
Indenture.	Water.	$300.00	70	$4.29	$0.26	$0.11	$4.66	$0.39	$1.25	$0.38	$0.13	$8.56
$0	282	0	70	0	0.26	0.11	0.37	0.39	2.50	0.75	0.13	4.14
1	282	282.00	70	4.03	0.26	0.11	4.40	0.39	1.25	0.38	0.13	6.55
1¼		352.50		5.04			5.41					7.56
1½		423.00		6.04			6.41					8.56
1¾		493.50		7.05			7.42					9.57
2		564.00		8.06			8.43					10.58
2¼		634.50		9.06			9.43					11.58
2½		705.00		10.07			10.44					12.59
2¾		775.50		11.08			11.45					13.60
3		846.00		12.09			12.46					14.61
3¼		916.50		13.09			13.46					15.61
3½		987.00		14.10			14.47					16.62
3¾		1,057.50		15.11			15.48					17.63
4		1,128.00		16.11			16.48					18.63
4¼		1,198.50		17.12			17.49					19.64
4½		1,269.00		18.13			18.50					20.65
4¾		1,339.50		19.14			19.51					21.66
5		1,410.00		20.14			20.51					22.66
5¼		1,480.50		21.15			21.52					23.67
5½		1,551.00		22.16			22.53					24.68
5¾		1,621.50		23.16			23.53					25.68
6		1,692.00		24.17			24.54					26.69
6¼		1,762.50		25.18			25.55					27.70
6½		1,833.00		26.19			26.56					28.71
6¾		1,903.50		27.19			27.56					29.71
7		1,974.00		28.20			28.57					30.72

The PRESIDENT. Has any one any questions he would like to ask Mr. HILL in connection with this matter? If there are no questions, as our time is somewhat limited we will pass at once to the last paper on the programme, "American Textiles at the Paris Exposition of 1900," by Mr. JOHN H. MCGIBBONS, Director of Exhibits of the United States for the Paris Exposition.

AMERICAN TEXTILES AT THE PARIS EXPOSITION OF 1900.

JOHN H. MCGIBBONS, *Director of Exhibits*,
Auditorium Building, Chicago, Ill.

In 1900 France will hold her fifth Universal International Exposition, the first having been held in 1855. With this experience in building expositions at home, and with that experience gained by participation in all expositions abroad, it may be truthfully asserted that France will make the coming exposition surpass all others in every particular except size. It is the purpose of its projectors to make it symbolical of the greatness of the closing century, by embodying therein the culmination of the best that the artists, the scientists, the inventors and the philosophers of all the past have produced. It is proposed that its grandeur will suggest the early realization of what the past did not dream, or at most considered only a wild imagination. The spot chosen for the exposition renders possible the architectural and artistic effect necessary to the realization of this wonderful achievement, and the manner in which the French and the other nations of Europe are vieing with each other to do the rest, make the exposition an assured realization of perfection and grandeur. The site is in the heart of Paris — *the* city of France — *the* city of Europe. The beautiful and historic Seine divides it, and magnificient boulevards surround and traverse it. It is easily accessible, and, while not as large by one-half as that of the White City in Chicago in 1893, it embraces all the ground occupied by the exposition of 1889 and sixty acres in addition, making 336 acres as the total area which will be devoted to this great exposition.

So great is the interest in the exposition that already all but two of the more than fifty nations have applied for space. The purchasers, the experts and the tourists from all countries, in fact the representatives of more than 500,000,000 of people will make the exposition of 1900 their Mecca, and the nation that makes the best display there will send these several millions of representatives and visitors back to their respective countries praising the merits of that nation's display as so many drummers from a colossal mercantile house. As an advertisement the exposition will afford all American producers such an opportunity that they will err who do not accept it.

The great activity of the nations in their preparation for the exposition makes it obligatory upon every manufacturer in the United States to lend his best efforts to enable every American product to have its best on exhibition, arranged not as at a county fair or as head stones in a cemetery, but in a manner that will command attention.

Although certain goods manufactured in the United States may not now, owing to duties and the home demands, have an extensive foreign sale, they should be shown in Paris in 1900 none the less in keeping with their actual development in this country, and every article displayed should be the best, and the United States exhibit, in every line, should be complete and attractively installed, so that it will demonstrate that America is no longer a nation in swaddling clothes as our exhibit in Paris in 1889 indicated, but a country which is a giant in all respects.

We trembled at the weakness of our fleet upon the seas until its prowess was recently made known. In fact whenever America has gone into competition in the last few years she has come off victorious. America should demonstrate at the Paris Exposition, when the best from every land will be on exhibition and when all eyes are centered there, that in the arts of peace she is no less supreme than in the science of war. The American sections of the exposition should convince beyond a doubt that the United States is a mammoth department store, to which one may come and buy everything, finding nothing of

inferior merit, but most things so vastly superior to all similar goods that can be found elsewhere that the foreign consumer will conclude that it will pay him in the end to come to the United States for all his goods.

The demands already made for space in the American sections give the assurance that our exhibit in nearly all the departments will not be excelled by those from any other country. By concerted effort the members of the New England Manufacturers' Association can display American cotton textiles, and many of those textiles of which cotton forms a part, so as to convey a good impression of the progress we have made in these lines, and be in every way creditable to the country. By such an exhibit we can best reach our South American friends, who continue to go to Europe to buy, through force of habit and through lack of perfect knowledge as to what we actually have to sell. Nothing should be left undone which will tend to divert from its present channel this enormous trade, which rightfully belongs to the United States.

The space allotted to the United States for threads, textiles and garments, is limited, amounting approximately to only 13,000 square feet, but a joint exhibit of the cotton manufacture would reduce the amount of space necessary and at the same time insure a more attractive and satisfactory exhibit.

It is suggested that a committee be appointed by the New England Cotton Manufacturers' Association to arrange for such an exhibit. This committee, as a whole, or through its chairman, might consult with similar committees representing the woolen and worsted, silk and other manufacturers, who will occupy the space in the textile section. These committees together, under the direction of the Commissioner-General, could determine upon a general plan of installation and decoration for the whole section, apportion the space therein, and render much valuable service in many ways. With the assistance of the influence of the Commissioner-General, which will be employed and given wherever possible, a joint exhibit would reduce the cost of exhibiting to the individual exhibitor to a minimum.

The members of the New England Cotton Manufacturers' Association are assured that every consideration and courtesy will be extended to them to make an exhibit in the line of cotton machinery and the products of manufactured cotton goods that will be most creditable to themselves and the United States.

The site to be occupied by the exposition comprises, in particular, the Champ de Mars, the Trocadero and its immediate surroundings, the quai d'Orsay, the Esplanade des Invalides, the quai de la Conference, the Cours-la-Reine, the Palais de l' Industrie and the grounds in the neighborhood of the Palace comprised between the prolongation of its longitudinal axis, avenue d'Antin and Cours-la-Reine.

Rules on details as to shipping, receiving, installing and returning of goods of American exhibitors will be issued later by the Commissioner-General.

From the General Rules and Regulations issued by the French government, it may be stated on matters pertaining to the interests of the members of the New England Cotton Manufacturers' Association:

All objects admitted will be introduced into the exposition between Dec. 1, 1899 and Feb. 28, 1900.

Machinery of all kinds will be, as much as possible, in motion under the eyes of the public, so as to show the modes of operation, and so that visitors may witness the different manufacturing processes. The raw material, the machinery, or process of manufacture, and the finished product will be exhibited side by side.

Exhibitors will not pay rent for the space occupied in the palaces and pavilions built by the management of the exposition.

Water, gas, steam and motive power necessary for working apparatus which is exhibited, will be supplied free of charge. Exhibitors will, however, furnish at their own expense the necessary piping for receiving water, gas, or steam, also the inter-

mediary transmissions required for the reception of the motive power on the driving belts.

The entire space occupied by the Universal Exposition of 1900 will be considered as a bonded warehouse.

Foreign products received into the exposition grounds will be taken charge of by the special customs department of the exposition, and according to the general rules of warehouses.

Awards to exhibitors of the contemporary exposition and to their *collaborateurs* will be made under the form of diplomas signed by the Minister of Commerce and Industry, of Posts and Telegraphs and by the Commissioner-General. They will be divided into the following categories:

Grand Prize Diplomas.

Gold Medal Diplomas.

Silver Medal Diplomas.

Bronze Medal Diplomas.

Honorable Mention Diplomas.

Exhibitors who shall have accepted the position of juror, or assistant juror, will be placed *hors coucours* (out of competition). This rule will apply to companies which exhibit and which are represented in the jury either by a director, or by any agent forming part of the permanent personnel of the company.

Blanks for application for space and information upon the Regulations and Classification of the Exposition will be forwarded by mail upon application.

The following excerpts from Groups XII and XIII of the General Classification are submitted to indicate the scope of textile exhibits desired from the United States.

The writer understands that the interests of members of the New England Cotton Manufacturers' Association are not confined exclusively to the manufacture of purely cotton goods and machinery, but extends into fabrics of which cotton forms only a portion, and that in these lines of fabrics from blended raw materials American manufacturers have shown especial skill and originality.

GROUP XII.

Class 69.—*Carpets, Tapestries and Upholstering Drapery Fabrics.*

(Machinery, processes and products.)

1. Special machinery in the manufacture of carpets and tapestries. Looms for making tapestries or carpets of high or low warp, etc.

Processes of the art of spooling thread.

2. Carpets. Wilton Carpets. Tapestries; light or imitation velvet; carpets of felt, matting, etc.

Upholstery fabrics in silk, wool, cotton, flax, jute, ramie, single color, mixture, figured, printed, embroidery, horse-hair cloth, vegetable leather, molakin, etc. Leathers for tapestry and upholstery. Oil cloth, linoleum.

GROUP XIII.

Class 75.—*Threads, Cloths, Garments, Materials and Processes of Spinning and Rope-making.*

Machines and processes for the manufacture and spinning of textile materials.

Apparatus and processes for complemental operation: winding on and off of bobbins, doubling, silk throwing; mechanical preparations.

Detached pieces pertaining to spinning and special machines serving for their manufacture.

Apparatus for determining the quality, apparatus of proofs and control and to determine conditions.

Materials of the workshop of a rope factory.

Class 76.—*Materials and Processes in the Manufacture of Textiles.*

Apparatus used for operations preparatory to weaving. Machines to lay out the warp, to wind on spools. Stretchers.

Ordinary and mechanical looms for weaving plain tissues.

Looms for the manufacture of cloth with designs and Jacquard looms.

Looms for the weaving of hosiery. Materials for the manufacture of lace and tulle.

Materials for the manufacture of trimmings.

Class 77.—*Apparatus and Processes of Bleaching, Dyeing, Printing and Preparation of Textile Materials in their Divers Conditions.*

1. Apparatus to boil, singe, brush, and to shear fabrics.

Apparatus to wash in lye, to cleanse, to wash, to air, to clean, to dry, to moisten the various textile materials, whether in the condition of meshes, of carded, of threads or of cloths.

Apparatus for boiling and sifting thickenings and colors.

Materials for engraving in embossment or in cavity for printing on cloth.

Machines to make silk handkerchiefs, to dye, to print, humidifying apparatus.

Machines of all kinds to prepare textiles for the market; machines to press, to alum, to water, to figure. Machines for measuring, folding, etc.

Materials for the treatment of colored silks; machines to thrash, to shake, to wring, to give a gloss, etc.

Sweating houses. Apparatus of a dye house. Electric bleaching.

Materials and processes for bleaching linen; lye washing, washing and rinsing, drying, ironing and dressing.

Industries of the dyer; dry cleaning with benzine and its derivatives; damp cleaning; dyeing; dressing.

2. Specimens of bleached or dyed textile materials of all kinds, before spinning and weaving.

Specimens of thread of cotton, flax, wool, silk, etc., pure or mixed, bleached, colored or dyed.

Specimens of bleached textiles, dyed or printed.

Specimens of starched threads or textiles.

Specimens for chemically removing flaws from textile materials before spun or woven.

Class 78.—*Materials and Methods of Sewing and Manufacture of Weaving Apparel.*

Ordinary tools used in the industries applied to sewing.

Machines for cutting cloths, skins, leathers.

Machines for sewing, for quilting, for hemming, for embroidering, etc., cloths, braid, straw; to sew leathers, shoes, etc.

Tailor's dummies and flat-irons.

Busts and artificial anatomical figures to exhibit clothing.

Machines to prepare detached pieces of shoes (for stamping, bending, etc.). Machines to pin, screw, tack, to make and shape shoes.

Machines for manufacturing straw and felt hats.

Class 79.— *Threads and Cotton Goods.**

Spun and prepared cotton.

Pure or mixed cotton cloth, plain or designed, unbleached, dyed or printed.

Cotton velvets.

Cotton ribbons.

Blankets.

Class 80.—*Threads and Flax and Hemp Linen. Products of Cordage.*

Thread of flax, hemp, jute, ramie and other vegetable fibers.

Linen cloths, plain or diapered. Ticking, damasks, cambrics and lawns. Plain and fancy handkerchiefs.

Flax or hemp linen mixed with cotton or silk.

Linen of vegetable fibers other than those of cotton, flax, hemp, jute, ramie, etc.

Products of cordage: cables, ropes, twines, etc.

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*This class and the three following comprise the unbleached or dyed threads, the unbleached, bleached, dyed, printed and starched cloths.

Class 81.— *Threads and Woolen Cloth.*

Combed wool. Threads of combed wool.

Picked wool. Raveled, unbleached or dyed. Threads of picked wool.

Cloth of combed and picked wool.

Cloth for ladies' wear.

Cloth for dresses of combed or picked wool, of wool mixed with cotton or silk.

Muslins, Scotch tweeds, merinos, Chinese satins, serges, etc.

Cloths of picked wool, milled or slightly milled: flannels, tartans, swanskins, etc.

Kent cloths in combed or picked wool.

Woolen shawls, pure or mixed. Cashmere shawls (so-called).

Ribbons or trimmings of pure wool or mixed with cotton, flax, silk or with floss of silk.

Hair cloth, pure or mixed.

Blankets.

Felt of wool or hair, for carpets, hats, shoes, etc.

Class 82.—*Silks and Silk Cloths.*

Raw, smooth and twisted silk.

Floss and waste of silk.

Threads of floss or of waste of silk.

Artificial silks.

Silk cloths, of floss silk or of waste silk, of silk or of floss of silk mixed with metallic threads, wool, cotton thread, etc., plain, stitched or diapered; unbleached, dyed or printed.

Velvets and plushes.

Silk ribbons, or of floss silk, pure or mixed.

Silk shawls, or of floss silk, pure or mixed.

Class 83.—*Laces, Embroidery and Trimmings.*

Hand-made laces: laces, blond laces, guipures, with distaffs, needle, crochet; in flax, cotton, silk, wool, metallic and other threads.

Laces made by machinery; plain and fancy tulle, imitations of laces, blonds and guipures, in threads of all kinds.

Hand-made embroideries: hand or crochet embroideries, in threads of all kinds and upon backgrounds of all kinds (lace, cloths, netting, tulle, skin, etc.), including needlework tapestries on canvas, as well as embroideries cut applique and adorned with precious stones, beads, jets, spangles of metal or of other products, as feathers, plumes, shells, etc.

Embroideries made by machinery, etc.

Trimming making: galons, braid or tresses, fringes, tassels and ornaments of all kinds, made either by hand or machinery, and trimmings for civil and religious garments, uniforms (civil or military), saddlery, carriages, trimmings, etc., spun and laminated plates, metals in gold and silver or plated, chenille spangles, and all articles especially used for trimmings.

Cassocks: ornaments and church linen, alter coverings, banners and other objects of worship trimmed with laces, embroideries and trimmings.

Lace curtains, guipure, embroideries on tulle or cloth; shades, screens, portieres, mantel piece coverings and all objects of drapery, decorated with lace, embroidery or trimmings.

Class 84.—*Industries of Ready Made and Sewing of Clothing for Men, Women and Children.*

Garments to order for men and boys: city attire, hunting, riding and sporting suitings; uniforms, both military and civic; breeches of skin and similar articles; robes and gowns for magistrates, lawyers, and members of the professions, ecclesiastics, etc.; liveries, various costumes for children.

Ready-made garments for men and boys.

Garments to order for women and young girls: dresses, vests, jackets, cloths (industries of women's tailoring, seamstresses, dress-makers and cloak-makers). Riding habits; sporting suits.

Ready-made garments for women and young girls. Dummies for manufacturing.

Class 85.—*Various Industries of Wearing Apparel.*

Hats: straw, felt and wool hats; fur and silk hats; caps; hatters' supplies.

Artificial flowers for head dress, for dresses and other use. Plumes. Millinery. Hair,

Shirt-making and haberdashery for men, women and children, Hosiery of cotton, wool, silk, floss of silk, etc.; knit hosiery. Cravats and neck-ties.

Corsets and corset materials.

Elastic goods, suspenders, garters and belts.

Manufacture of gloves.

Men's, women's and children's foot-wear: Boots, low shoes, shoes, slippers, pumps, rubbers, soles, findings, etc. Gaiters. Walking sticks, whips, riding whips, small parasols, parasols, umbrellas.

Buttons: Ceramic buttons, metal, trimming buttons, pearl and other shells, horn and bone, papier-mache, etc. Buckles, eyelets.

Fans; hand screens.

INDEX.

A

Active Members 12
Adams, Alfred E., Cost of Supplies for Plain Looms 243
Adams, Alfred E., Standard Twist 213
Alphabetical List of Members . . 12
American Cotton Company . . . 266
American Textiles at Paris Exposition 339
Apprisal of Mills 222
Armstrong, Thomas, Vertical Engines 261
Attendance at Crawford Meeting 57
Associate Members 25

B

Back Numbers of Transactions . 45
Bale Placed on Lapper 266
Banding for Spindles 248
Bell, John, on Linen Manufacture 116
Bell, John, on Mercerized Cotton 146
Belts, Care of 170
Beverly Cotton Mill 290
Bleaching and Dyeing 169
Blending Cotton 189
Board of Government 9
Boston Manufacturing Company, Establishment of 283
Bourne, Stephen N., Costs . . 126
Bourne, Stephen N., Drying Fabrics 239
Bourne, Stephen N., The Labor Market at the South 165
Bourne, Stephen N., Montreal Meeting 80
Bourne, Stephen N., Packing of Goods 257
Brown, Isaac A., Elected Active Member 81
Brown, Moses, Quaker Capitalist 295
Brundage, Percy H., Linen Manufacture 111
Brundage, Percy H., Tariff Adjustment 106
Bushnell, Fred W., Elected Associate Member 82
Buying Cotton 189

C

Care of Belts 170
Cartwright, Edmund, Weaving Machine 300
Charter 3
Charter, Amendment to 4
Classification of Textiles at Paris Exposition 344
Constitution and By-Laws . . . 5
Core of Round Bale 275
Costs, Committee on 123
Cost per Horse Power 333
Costs of Manufacture 129
Cost of Spinning, per Pound . . 130
Cotton Bale, Permanence of . . 265
Cotton Consumed by Southern Mills 164
Cotton Crash 100
Cotton Goods, Values of . . . 96

Cotton Grading and Mixing, Arthur Whittam 188
Cotton, Mercerized 134
Cotton Mills, Different Values of, William F. Sherman 222
Cox, Thomas G., South American Trade 78
Crapo, William W., Elected Active Member 81
Crash Made from Cotton . . . 100
Crawford Meeting, Attendance . 57
Crosby, William W., Textile Instruction 75
Crosby, William W., Principal of Lowell Textile School . . . 262
Crows' Nests in Cotton 172
Cumnock, A. G., President Lowell Textile School 262
Cylindrical Lap Bale 265

D

Dana, Philip, Elected Active Member 81
Davis, Jones S., Value of Linen Imports 96
Dibble, Samuel, Elected Active Member 81
Different Values of Cotton Mills, William F. Sherman 222
Discussion on Cotton Yarn Mill Costs 123
Dodge, Charles Richard, Investigation on Fibres 93
Dodge System of Rope Driving . 221
Dog Days in Southern Mills . . 159
Draper, George Otis, Imperfections in Spinning Rings . . . 252
Drawing, Uniformity of 269
Drying of Textile Fabrics, Chas. H. Fish 226
Dunham, Joseph M., Cost of Baling Cotton by Round Bale 273
Dunham, Joseph M., Length of Staple 193
Dunham, Joseph M., Twisting on Ring Frames 207
Dyeing and Bleaching 169

E

Early History of Power Loom, A. M. Goodale 283
Eccentricity of Spinning Rings . 254
Eccles, John, Cost per Loom . . 132
Eccles, John on Mercerized Cotton 141
Eccles, John, on Ring Filling . 167
Eccles, John, Taper on Mule Cops 174
Emmons, T. A., Pioneer in Loom Harness business . . . 184
Export of Linen from United Kingdom 94

F

Fall River, Manufacturing Condition 162
Felt, Annalist of Salem 295
Filling Frames Competing with Mules 166
First Selling House for Mills . . 286
Fish, Charles H., Drying Fabrics 226
Fish, Charles H., Packing of Goods 257
Fish, Charles H., Twisting Ring Frames 211
Flather, Frederick A., Drying Fabrics 238
Flather, Frederick A., Cost of Mercerization 149
Flather, Frederick A., Imperfections in Spinning Rings . . 253
Flather, Frederick A., Slasher Cylinder Bearings 195
Flax, Imports of 95
Foreign Trade 76
Founding, Date of 5
Freight on Round Bales 271

Friction, Loss of in Power Transmission 261
Frost in Cotton 275
Fuel, Cost of at the South . . . 155
Furbush, M. A. Correspondence 86

G

Geographical List of Members . 30
German Mercerization of Cotton 138
Gilligan, John, Elected Active Member 81
Goodale, A. M., Early History of Power Loom 283
Granger, William S., on Drying Fabrics 237
Granger, William S., Foreign Trade 76
Gulliver, Arthur H., on Ring Filling 167
Gulliver, Arthur H., on Standard Twist 214

H

Handling Round Bales 271
Harnesses 178
Harness Making Machine . . . 179
Harnesses, Varnishing of . . . 182
Harris, Pioneer in Loom Harness Business 184
Hawes, William B., on Costs . 127
Headquarters 89
Heat of Steam 229
Help in Southern Mills 158
Hill, Capt. James G., on Horizontal Turbines 261
Hill, Capt. James G., Relation of Steam to Water Power . . 333
Holden, Isaac, Application of Power to Wool Combing . . 111

I

Important Features relating to Ring Spinning and Cost of Supplies for Plain Looms, Alfred E. Adams 243
Imports of Flax 95
Imports of Linen 96
Incorporation Data 5
Insurance Policies 223
Insurance on Round Bales . . . 271
Invoice Rates on Round Bale . . 272
Irish Linen Interests 98
Itinerary of Trip to Crawford House 62

J

Jennings, Edward B., Elected Active Member 81

K

Kendall, James H., Elected Associate Member 82
Kendrick, John, Established Harness Manufacture in Providence 179
Kendrick, John, on Mercerized Bands 149
Kendrick, Joseph H., Manufacture, Use and Care of Loom Harnesses and Reeds 174
Knight, C. Prescott, Elected Active Member 81
Knight, Stephen A., Closing Address 88
Knight, Stephen A., Machinery about Right 210
Knight, Stephen A., Packing Goods for Bleacheries 259
Knight, Stephen A., President's Address 68
Knight, Stephen A., Rope Driving 221
Knight, Stephen A., Twisting on Ring Frames 208
Knight, Webster, Elected Active Member 82

L

Labor Market at South 166
Lacey, Fred, on Mercerized Cotton 144
Linen, Fabric of the Stone Age . 93
Linen Manufacture in New England, S. N. D. North 92
Linen, Permanence of 93
Linen Schedule in Tariff 105
Lister, Samuel, Combing of Silk Waste 111
Long Rolls for Bleacheries . . . 257
Loom, Early History of 283
Loom Harness Association . . . 183
Loom Harnesses 178
Looms, Setting of 183
Lovering, William C., Elected Active Member 82
Lovering, William C., Some Advantages of the Cylindrical Lap Bale 265
Lowell, Francis C., Establishing Cotton Manufacturing 283
Lowell Machine Shop, Roller Bearings for Slasher Cylinder 196
Lowell Textile School . . . 75–262
Lyman, Arthur T., ... 296

M

Machine Values in Mills 224
Manufacturing, Cost of 156
Manufacture, Use and Care of Loom Harnesses and Reeds, Joseph H. Kendrick 178
Mayor, Thomas, Standard Twist 213
Mayor, Thomas, Twisting on Ring Frames 212
Meats, John Tempest, Taper on Mule Cops 174
Medals at Paris Exposition . . 343
Meeting, Call to 61
Members, Alphabetical List of . 12
Members, Geographical List of . 30
Membership, Total 29
Membership, Location of . . . 34
Mercerized Cotton 134
Mercerized Spinning Bands . . 145
Mercer, John, Patent for Treating Cotton 134
Metropolitan Water Board, Apprisal of Mills 225
McGibbons, John H., American Textiles at Paris Exposition . 339
Miller, R. M., Jr., Elected Active Member 82
Miller, R. M., Jr., Southern Labor Market 166
Miller, R. M., Jr., Southern Manufacturing 164
Mixing Cotton 189
Montgomery, J. R., Elected Active Member 82
Montgomery, J. R., Mercerized Cotton 134
Montgomery, J. R., on Round Bales 282
Montreal, Invitation to 85
Montreal, Proposed Meeting at . 79
Moody, Paul, Mechanic at Waltham 284
Mule Cops, Taper on 173
Mulhall on Flax Growing . . . 99

N

Net Advantages of Southern Mills 161
Newell, George C., Elected Associate Member 82
New Hampshire, Governor of . 67
New Members, Election of . . . 81
North, S. N. D., Linen Manufacture in New England 92

O

Officers of the Association . . . 10
Operatives in Southern Mills . . 160

P

Packing of Goods for Printing Works and Bleacheries . . . 257
Paris Exposition, American Textiles at, John H. McGibbons . 339
Patterns of Looms 297
Phipps, Benjamin, Elected Active Member 82
Power Loom, Early History of, A. M. Goodale 283
Power Loom, English Origination of 284
President's Address 68
President's Closing Address . . 88
Print Works and Bleacheries, Packing of Goods for 257
Proceedings 57
Process of Mercerization 134
Programme of Meeting 64

R

Ramie Fibre 140
Ramsdell, Hon. George A., Governor of New Hampshire . . . 67
Rantoul, Robert S., Early Cotton Manufacturing 289
Reeds, Adjustment of 184
Reeds, Good Workmanship Essential 185
Reeds 178
Resolution on Meeting at Montreal 85
Resolution upon Textile Instruction 67
Richardson, Charles H., Twisting on Ring Frames 209
Richardson, Charles H., Standard Twists 213
Ring Filling 167
Ring Frames as Substitutes for Twisters 206
Ring Travelers, Alfred E. Adams 243
Ring Travelers, Table of . . . 246
Roller Bearings for Slasher Cylinders 196
Rope Driving 217
Ross, John H., on Flax Manufacture 101
Rostron, John R., Elected Active Member 82
Round Bale 266
Round Bale, Sampling of . . . 275
Russian Flax 100

S

Salt, Titus, on Alpaca 140
Schaefer, H. T., Elected Associate Member 82
Sheeting, Price of 286
Sherman, William F., Different Values of Cotton Mills . . . 222
Shrinkage in Mercerization . . . 150
Shrinkage in Weaving 184
Simpson, Louis, Drying Fabrics 237
Simpson, Louis, Frame Filling . 169
Simpson, Louis, Meeting at Montreal 79
Simpson, Louis, Mercerized Cotton 148
Simpson, Louis, Ring Filling . . 167
Simpson, Louis, Rope Driving . 220
Simpson, Louis, Sampling from Round Bale 274
Simpson, Louis, Standard Twist 213
Simpson, Louis, Table of Costs . 129
Simpson, Louis, Theoretical Production 124
Sladdin, Joseph, Manufacturer of Harnesses 180
Slasher Cylinder Bearings, Frederick Flather 195
Slater's Mills at Pawtucket . . . 287
Slubbers Without Intermediates 217
Some Advantages of the Cylindrical Lap Bale, William C. Lovering 265

Southern Cotton Mills and Cotton Manufacturing, Edward B. Wilbur 154
Southern Mills, Cost of 154
Spindle Banding 248
Spindles in Southern Mills . . . 164
Spinning Bands, Mercerized . . 145
Standards in Spinning Rings . . 253
Standard Twist 212
Staple, Length of 193
Stevens, Henry H., Pioneer in Linen Manufacture 107
Supplies for Looms 250

T

Table of Power Cost 335
Tanks for Pulleys 260
Taper on Mule Cops 173
Tariff on Cottons 287
Taxes on Mill Property 155
Testing Cotton 190
Test of Laps from Cylindrical Bale 268
Textile Classification at Paris Exposition 344
Textile Instruction, Resolution upon 67
Textile School at Lowell 75
The Possibilities of a New Method for Drying Textile Fabrics, Chas. H. Fish . . . 226
Topical Question 92 . . . 64–74–166
" " 94 . . . 64–74–170
" " 95 . . . 64–74–170
" " 99 . . . 64–74–173
" " 100 . . . 65–79–206
" " 101 . . . 65–79–212
" " 102 . . . 65–83–217
" " 103 . . . 65–83–217
" " 104 . . . 65–84–257
" " 105 . . . 65–84–260
" " 106 . . . 66–84–261
" " 107 . . . 66–87
Topical Question 108 . . 66–87
" " 109 . . 66–87
" " 110 . . 66–87
" " 111 . . 66–87
Transactions, Back Numbers of 45
Travelers, Cost of 257

U

Underwood, Frank H., on Rope Driving 217

V

Vacuum Drying Fabrics 226
Varnishing of Harnesses 182
Vaughan, William P., Elected Active Member 82
Vertical Engines 261
Vibration of Ring Rails 244

W

Wages in Southern Cotton Mills 157
Waltham, Establishment of Cotton Manufacture at 283
Ward, Benjamin C. 286
Warden, Alexander J., Historian of Linen Industry 94
Waste Products of Mill 171
Waste, Utilization of 171
Water, Power, Cost of 156
Water Power, Relation of Steam to, James G. Hill 333
Webber, Col. Samuel, Horizontal Turbines 260
Webber, Col. Samuel, Linen Manufacture 118
Welch, William, Twisting on Ring Frames 208
Whiting, William B., Mill Valuations 223
Whittam, Arthur, Cotton Grading and Mixing 188
Whittam, William, Jr., Cotton

Yarn Mill Costs 122
Wilbur, Edward B., Southern Cotton Mills and Cotton Manufacturing 154
Windsor, Joseph S., Harness Making Machine 179
Woodbury, C. J. H., Utilization of Waste 172

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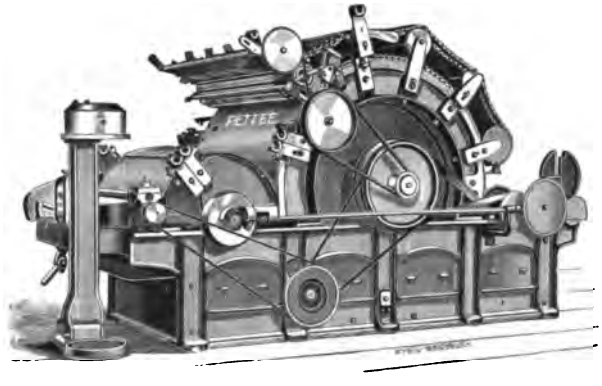

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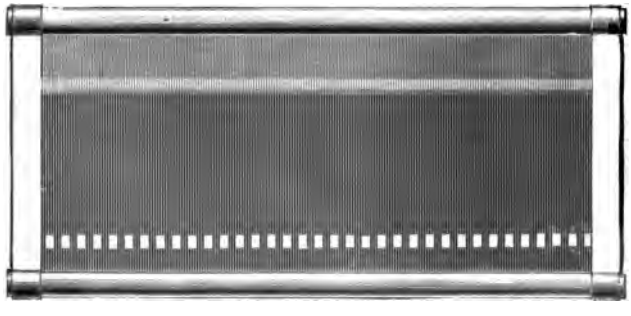

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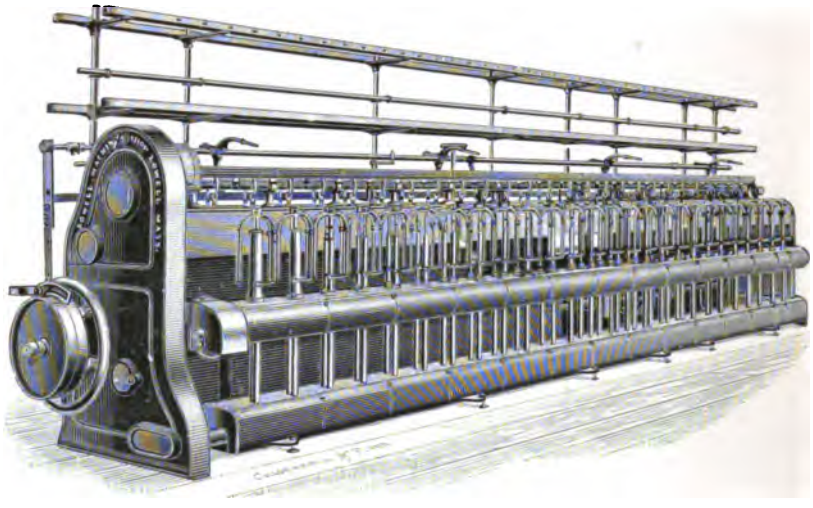

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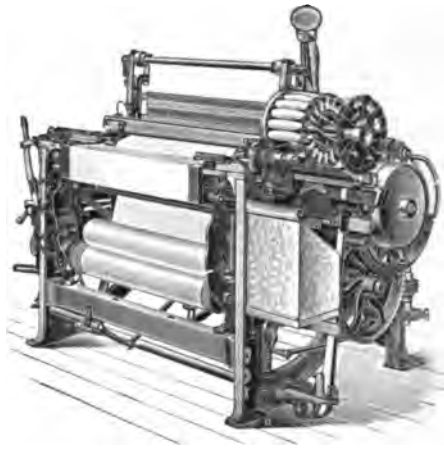

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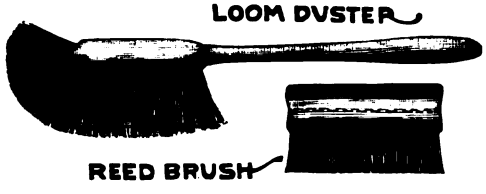

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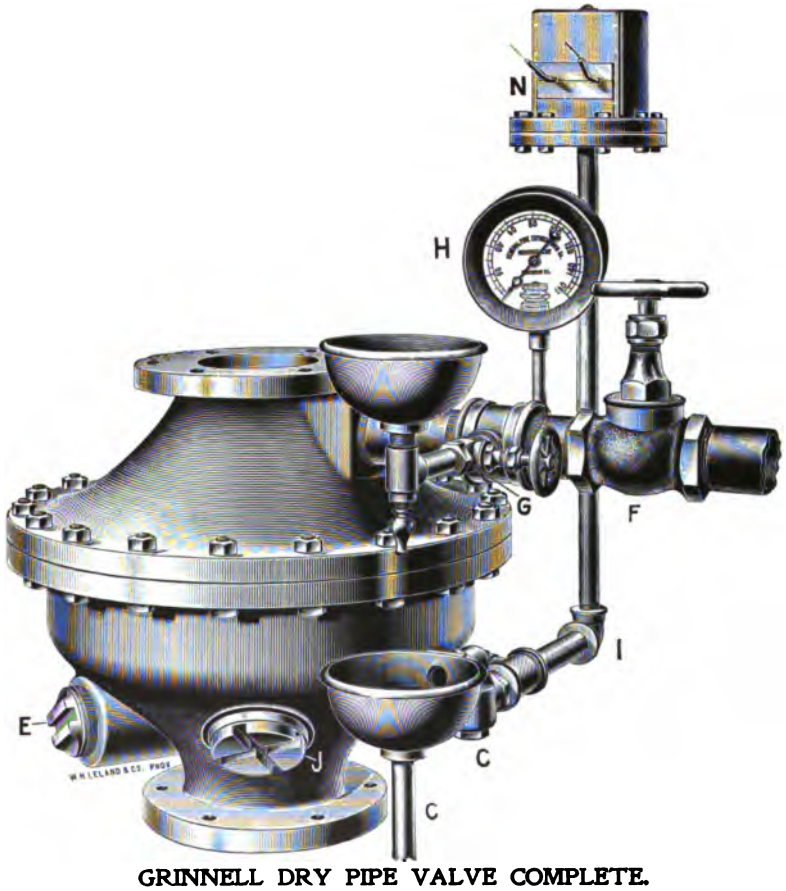

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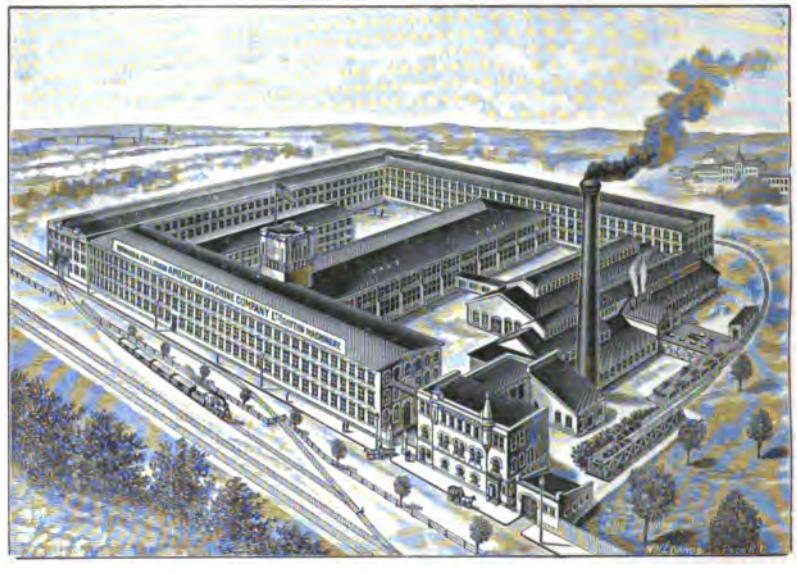

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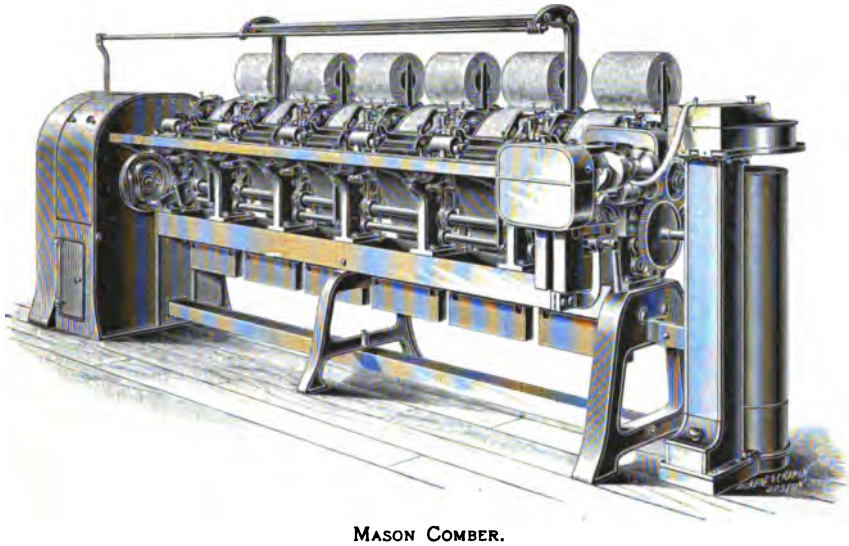

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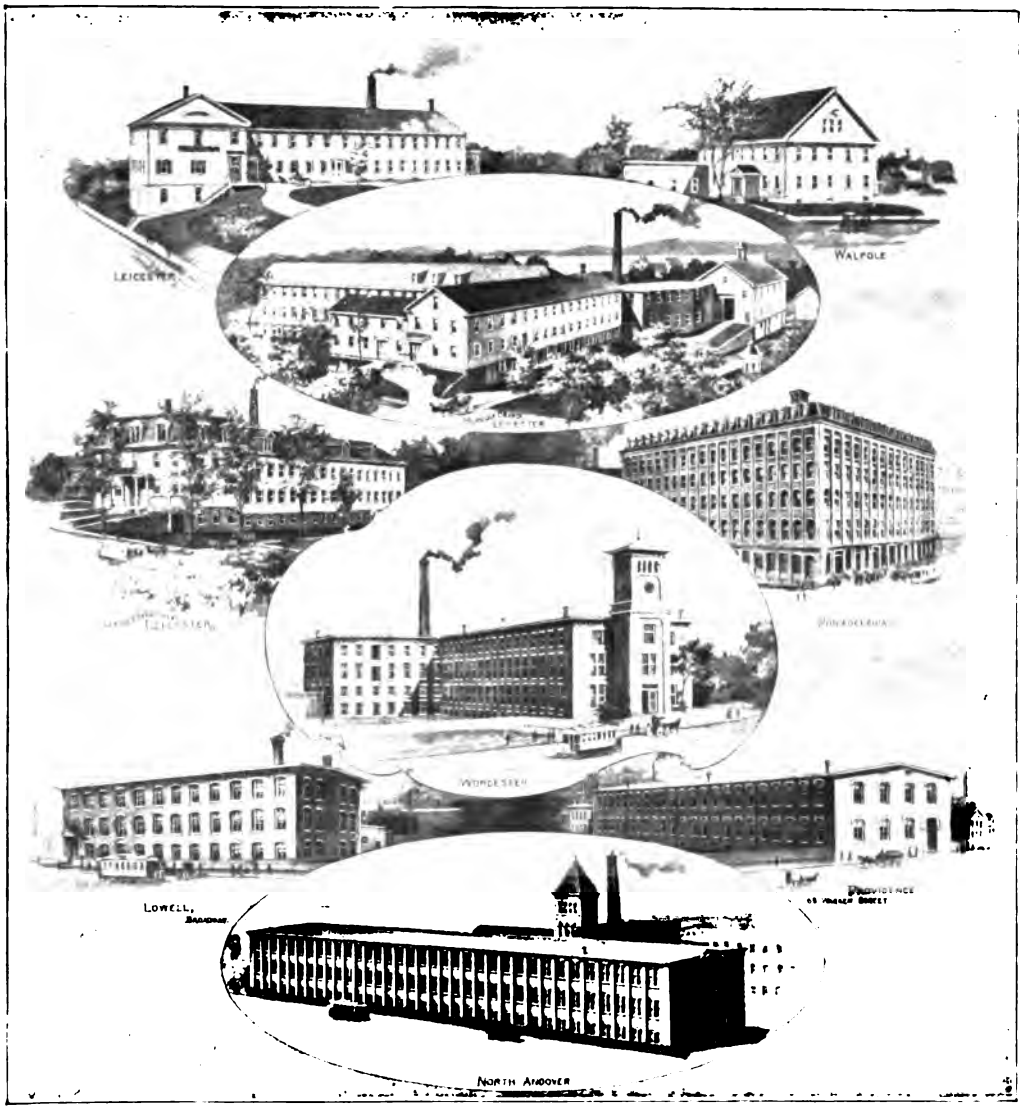

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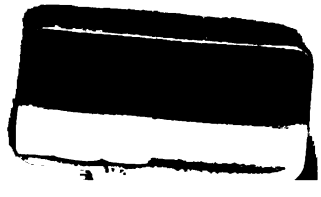
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